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THE

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"A time will come when the science of destruction shall bend before the arts of peace,—when the genius which multiplies our powers, which creates new products, which diffuses comfort and happiness among the great mass of the people, shall occupy in the general estimation of mankind, that rank which reason and common sense now assign to it."—ARAGO.

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| Warrington | Tanning | 25 March | .... | .... | 240 |
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## LIST OF IRISH PATENTS, FROM JANUARY 28 TO JUNE 13, 1846.

Henry Blumberg, of Camberwell-grove, Surrey, distiller, for improvements in the purification of spirits for the use of brewing-distillers and rectifiers. January 28.

Ernest Edge, of Manchester, Lancaster, mechanic, for improvements applicable to the wheels and axles of engines, tenders, carriages, and wagons, to be used upon railways. January 28.

John Lord, of Friday-bridge, Birmingham, merchant, for improvements in supplying steam-boilers with water. January 28.

Alfred Watney, of Wandsworth, Surrey, gentleman, for improvements in the manufacture of horse-shoes, and in applying shoes to horses and other animals. January 28.

William Sykes Ward, of Leathley Lodge, Hunslet-lane, in the parish of Leeds, York, gentleman, for improvements in exhausting air from tubes or vessels for the purpose of working atmospheric railways, and for other purposes; and improvements in the valves and tubes of same. January 28.

William Eccles and Henry Brierley, both of the township of Walton-le-Dale, Blacham, Lancaster, for improvements in machinery or apparatus for spinning. February 4.

Charles Henry Joseph Forrett, of Lile, in France, but now of No. 17, Great St. Helen's, Bishopsgate, for a new improved Archimedian screw, which he calls "Davaine's screw." February 4.

Frederick Bankart, of Champion-park, Denmark-hill, Surrey, gentleman, for certain improvements in heating certain metallic ores and refining the products therefrom. February 14.

Paul Ackerman, of No. 1, Size-place, in the city of London, for certain improvements in harpoons and other similar instruments. February 25.

John Walker, of Manchester, silk manufacturer, for improvements in weaving or manufacturing piled or napped cloths or fabrics, and also for improvements in machinery for cutting the pile or nap of the same. March 3.

William Henson, of Tabor Cottage, Wharf-road, City-road, Middlesex, civil engineer, for improvements in machinery for weaving. March 4.

John Harcourt Brown, of Brunswick-place, Barnsbury-road, Middlesex, gentleman, for improvements in securing letters, envelopes, covers, despatches, packets, and parcels. March 4.

John Faltrineri, of 1, Skinner's-place, Size-lane, London, gentleman, for certain new and improved modes of obtaining and applying motive power. March 7.

John Field, jun., of West Brixton, Surrey, gentleman, for improvements in apparatus for ascertaining the alcoholic strength of liquids. (Communication.) March 7.

John Berkeley Cotter, of Dublin, gentleman, for improvements in the preparation and manufacture of woven fabrics, applicable to various purposes. March 9.

Conrad Haverkam Greenhow, of North Wales, gentleman, for improvements in the construction of railways and railway carriages. March 9.

Thomas Henry Russell, of Wednesbury, Stafford, tube manufacturer, for improvements in the manufacture of welded iron tubes. March 9.

John Dearman Dunnicliff, of Nottingham, lace manufacturer; and William Bull Dexter, of the same place, lace maker, for improvements in the manufacture of warp fabrics. March 10.

Joseph Douglas, of Cross Cheaping, Coventry, furnishing ironmonger, for improvements in the patterns used for casting and in casting metals. March 10.

Nathaniel Chappell, of Arcadian Villa, Cumberland-road, Bristol, gentleman, for improvements in the manufacture of worts. March 10.

John Constable, of London, for certain improvements in the manufacture of gas for lighting and heating. (Communication.) March 10.

Juan Nepomuceno Adorno, of Mexico, gentleman, for improvements in the manufacture of cigars and other similar articles. March 11.

Robert Griffiths, of Havre, France; George Hinton Bovill, of Millwall, Middlesex; and George Hennett, of Bristol, engineers, for improvements in the construction of parts of apparatus used for propelling carriages and vessels by the atmosphere, and improvements in propelling carriages and vessels by atmospheric pressure. March 19.

Alfred Vincent Newton, of 66, Chancery-lane, in the county of Middlesex, mechanical draughtsman, for improvements in combing wool. (Communication.) March 20.

Joseph Zambeau, of Paris, France, chemist, for improvements in atmospheric railways. March 20.

William Henry Fox Talbot, of Lacock Abbey, Chippenham, Wilts, Esq., for improvements in obtaining motive power, and in the application of motive power to railways. March 20.

William Shaw, of Canning-place, Liverpool, for a machine for paging books and numbering documents consecutively and otherwise, and for printing dates, words, marks, numbers, or impressions, in an expeditious manner. March 23.

John Ainslie, of Alperton, Middlesex, brick and tile-manufacturer, for certain improvements in the arrangements for the manufacture of bricks, tiles, and other similar articles, from clay and other plastic substances, and in machinery or apparatus for the manufacture of bricks. March 27.

Frederick Rosenborg, of Kingston-upon-Hull, gentleman, and John Malam, also of the same borough, for certain improvements in, or apparatus for, watering, manuring, and drying, trees, plants, seeds, and roots, and for accelerating and improving the growth and produce of trees, plants, seeds, and roots. March 27.

William Edward Newton, of 66, Chancery-lane, Middlesex, civil engineer, for improvements in the preparation or manufacture of thread or yarn. (Being a communication.) March 28.

Henry Dircks, of Nicholas-lane, London, engineer, for improvements in the means of obtaining and preparing extracts from certain vegetable matters, and in the apparatus connected therewith, which apparatus may be also applied to other similar purposes. April 1.

William Unsworth, of Derby, silk manufacturer, for certain improvements in looms for weaving. April 1.

Charles Tetley, of Bradford, Yorkshire, stock and share broker, for certain improvements in the means of raising and impelling water and other liquids; or in machinery for such purpose or purposes; and also thereby to obtain mechanical power. April 3.

Moses Poole, of Serle-street, London, gentleman, for improvements in filling bottles and other vessels; and also in covering, stopping, or securing liquids and other matters in bottles and other vessels. (Being a communication.) April 3.

Wilton George Turner, of Gateshead, Durham, doctor in philosophy, for an improved mode of treating guano, for the purpose of obtaining chemical compounds therefrom. April 9.

John Lake, of Apsley, Hertford, civil engineer, for certain improvements in propelling. April 15.

John Nott, of Cork, gentleman, for improvements in the means of communicating intelligence from one place to another. April 20.

James Laming, of Mark-lane, London, merchant, for improvements in making the cyanides and ferrocyanides of potassium and sodium. (Being a communication.) April 20.

Henry Clark, of Redcross-street, Cripplegate, London, oil-merchant, and George Roberts, of Wells-street, Cripplegate, aforesaid, miner, for improvements in the construction of lamps; and in the preparation of materials to be employed for producing illumination. April 28.

Robert William Sievier, of Henrietta-street, Cavendish-square, Middlesex, gentleman, for certain improvements in looms for weaving, and in the mode or method of producing plain or figured goods or fabrics. May 2.

Edward Auguste Desire Guichard, of Rue des Jeuneurs, Paris, France, for improvements in printing calicoes and other fabrics. May 2.

William James Cantelo, of Paris-street, North Lambeth, Surrey, gentleman, for improvements in apparatus for hatching eggs and raising the young, and for heating hothouses and other buildings. May 5.

George Howell, of Larkhall-lane, Clapham, Surrey, gentleman, for certain improvements in coating with a metal the surface of articles formed of copper or copper alloys, or iron, wrought or cast. (Being a communication.) May 5.

George Wilson, of St. Martin's-court, St. Martin's-lane, Middlesex, stationer, for improvements in the cutting of paper for the manufacture of envelopes. May 13.

Henry Smith, of Liverpool, engineer, for improvements in the manufacture of wheels for railways and in springs for railway and other carriages, and in axle guards for railway carriages. May 13.

Peter Carmichael, manager for Baxter, Brothers, and Co., flax-spinners and linen-manufacturers in Dundee, for improvements in hackling or dressing flax, hemp, and other fibrous substances, and improvements in machinery for rubbing, stretching, and equalizing the breadth of cloth made from flax, hemp, jute, and other fibrous substances. May 14.

Pierre Armande Lecomte de Fontainemoreau, of No. 1, Skinner's-place, Size-lane, London, (Communication,) for certain improvements in apparatus for raising and supporting vessels, and other floating or sunken bodies, and its application for the better preservation of life and property. May 19.

John Robert Johnson, of Alfred-place, Blackfriars, Surrey, chemist, for improvements in purifying gas, and in the treatment of products of gas-works. May 19.

Richard Archibald Brooman, of the Patent Office, 166, Fleet-street, London, gentleman, for certain improvements in dyeing. (Communication.) May 25.

James Allingham, of Dublin, Ireland, gentleman, and the Rev. James William M'Gawley, of Dublin, for certain improvements in steam engines. May 29.

John Davie Morries Stirling, of Blackgrane, North Britain, esq., for certain new alloys, and metallic compounds, with a method of welding the same and other metals. June 1.

Robert Brett Schenck, of New York, gentleman, for certain improvements in the preparation of hemp and flax. June 4.

Willam Ashby, of Croydon, Surrey, millwright, for certain improvements in the manufacture of flour. June 12.

Elijah Galloway, of 14, Buckingham-street, Strand, Middlesex, civil engineer, for improvements in locomotive engines. June 13.

# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE

No. 1169.] SATURDAY, JANUARY 3, 1846. [Price 3d.

Edited by J. C. Robertson, No. 166, Fleet-street.


## WYLAM'S PATENT IMPROVEMENTS IN HYDRAULIC PRESSES.

Fig. 1.

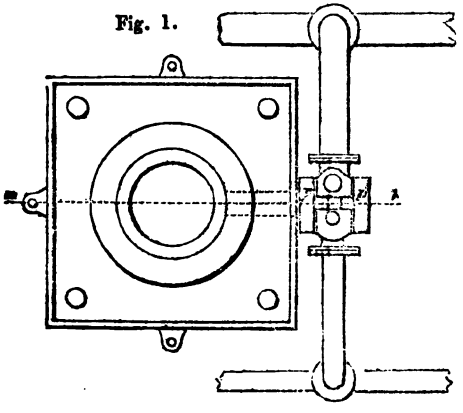
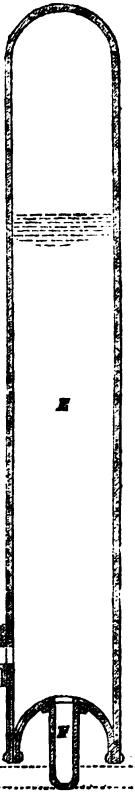


Fig. 6.



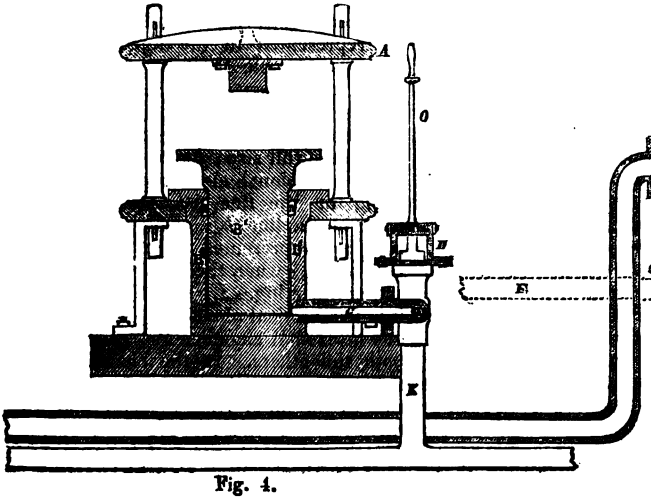



Fig. 4.

Fig. 3.

## WYLAM'S PATENT IMPROVEMENTS IN HYDRAULIC PRESSES.

[Patent dated April 25; Specification enrolled October 25, 1845.]

It is stated with truth in the introduction to the specification of this patent, that "hydraulic presses, as at present constructed and worked, are suitable only for producing high pressures at a slow rate of speed, and with considerable intervals of time between each charge and that next succeeding it, (the pumps requiring to be stopped for a time at every descent of the piston or follower,) and are wholly inapplicable to mechanical operations requiring a quick succession of strokes, or impulses, and as well strokes and impulses of a small or moderate, as of a high power."

Mr. Wylam has applied his ingenuity to the remedy of these defects, and has succeeded in producing what will be universally admitted to be a most important improvement in this branch of mechanical science—namely, a hydraulic press which "can be worked unintermittingly at great rates of speed, and at both high and low pressures."

Fig. 1 is a plan of one of a set of six hydraulic presses, placed in a row, side by side; fig. 2, a plan of a triple set of pumps, which communicate with a reservoir or accumulator of power, shown in plan, in fig. 3, (instead of communicating, as usual, directly with the press or presses,) and from which reservoir the power is supplied to the press or presses; fig. 4 is a sectional elevation of the press on the line *a b* of the plan, fig. 1; fig. 5 is a sectional elevation of the pumps on the line *c d* of the plan, fig. 2; and fig. 6 is a sectional elevation of the reservoir on the line *e f* of the plan, fig. 3. A, is the framework of the press, which is mounted as usual on a strong foundation of stone or brickwork; $B^1$, is the cylinder, and $B^2$, the piston or follower; C, the pipe for the inlet of the water under the piston; D, is a valvular governor for regulating the admission and escape of the water to and from the press, and which is of the peculiar construction separately represented in figs. 7 and 8; E, is the reservoir, which consists of a wrought iron air-tight vessel, which rises considerably above the level of the press, and is of a capacity many times greater than that of the cylinder of the press, and of a strength more than sufficient to resist any pressure to which the press itself is required to be subjected; F, is a pipe by which the reservoir E communicates with the valvular governor D; $G^1$ $G^2$ $G^3$, are the three pumps before-mentioned, (connected with and worked by a steam-engine or any other convenient first mover,) from which water is forced up from the cistern H, through the pipe I, into the reservoir E; *q q q*, are air cocks attached to the suction pipes of the pumps below the lower valves; K, is a return pipe, which conveys the water employed in producing each stroke of the piston back into the cistern H, from the valvular governor D. The reservoir E is made of larger capacity than either the press cylinder $B^1$, or the supply cistern H, because it is intended to hold not only all the water which can be pumped into it from H, but all the air which was contained in it originally, and which is forced by the water up to the top of it in a highly compressed state, and also any air which may be injected into the reservoir by the pumps under the circumstances to be hereinafter explained. A reservoir bearing the proportion to the press cylinder $B^1$, and supply cistern H, which E is represented to do in the figures, would contain water enough for about forty-two single press charges, or six charges for each set of six presses; and three pumps (as represented in the figures) would suffice to enable the reservoir to keep these presses constantly at work. The figures 7 and 8 represent the valvular governor D, as of nearly about one-eighth the full size; fig. 7 is a plan, and fig. 8 a sectional elevation of it; fig. 7 being on the line *g h*, of fig. 8, and fig. 8 on the line *k i*, of fig. 7. All the parts are represented as in the position they assume when the pumps are in the act of injecting. L, is a box divided into two vertical chambers, $M^1$ $M^2$, and one horizontal chamber $M^3$, common to both the others. In the chamber $M^1$, there is a port, $R^1$, which gives admission to the water from the reservoir E, through the pipe F; and in the chamber $M^2$, there is another port, $R^2$, communicating with the pipe C, which conveys the water to the cylinder of the press; T is a third port in the chamber $M^3$,

Fig. 5.

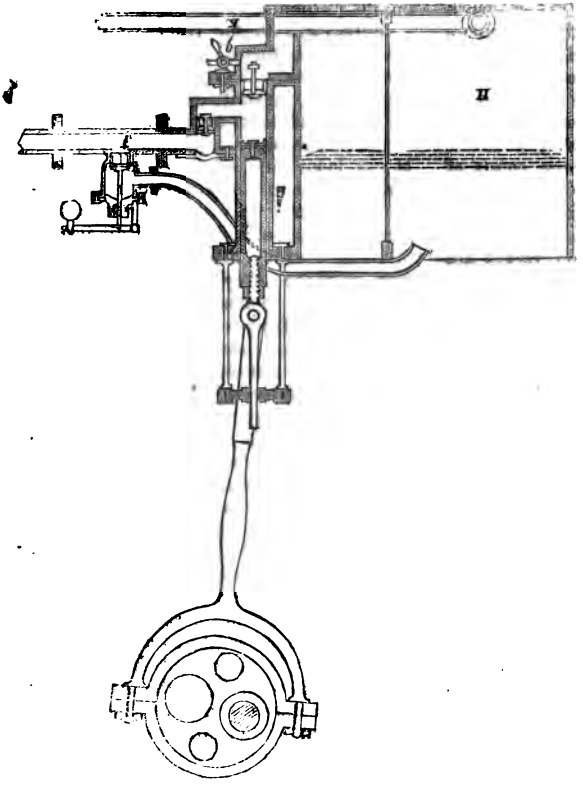



Fig. 8.

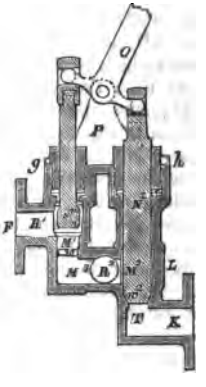



Fig. 2.

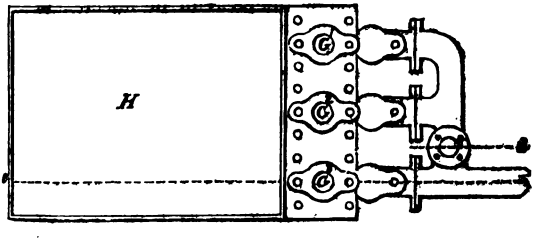
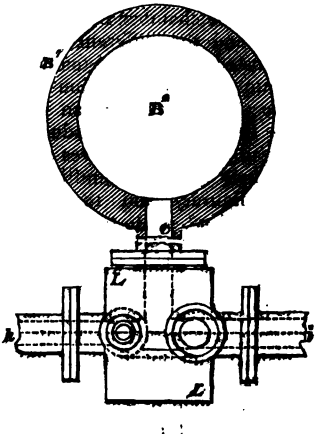



Fig. 7.



which opens into the discharge or return pipe K; $N^1$ $N^2$, are two plain-stemmed piston valves, which work freely up and down in the chambers $M^1$ $M^2$, through leathern collars and stuffing boxes S S, and open and close the different ports according to the different positions they are made to assume; O, is a double-ended hand lever, which is connected to the tops of the stems of the two piston valves, and turns on a pin or fulcrum, supported by the standards P P, by the movement of which lever to and fro, the piston valves are alternately raised and lowered. The chamber $M^2$, which contains the port T, leading to the return or discharge pipe K, is of larger capacity than the chamber $M^1$, and the piston valve $N^2$ which works in it is of a correspondingly larger size than the valve $N^1$ of the chamber $M^1$; and these larger dimensions are given to the chamber $M^2$, and the piston valve $N^2$, in order the better to facilitate the discharge of the water. But by enlarging the stem of the lesser piston valve $N^1$, at the bottom end, from *m* to *n*, (as shown in fig. 8,) and thus increasing the surface exposed to the pressure of the injected water, a perfect balance is established between the two piston valves. In fact, so complete is the equipoise between the two piston valves when they are thus constructed, (that is to say, when they are constructed according to the relative proportions represented in fig. 8,) that the lever is turned by hand with the greatest ease, equally to the one side or the other. The chamber $M^2$, and piston valve $N^2$, are, moreover, made considerably longer than the chamber $M^1$, and piston valve $N^1$, and the difference in length is so adjusted that the piston valve $N^2$, shall quite close the eduction port T, before the piston valve $N^1$ can rise so high as to throw open the induction port $R^1$. Again, the piston valves are bevelled off at their lower extremities, as shown in the figures, and these ends fit into seats $w^1$ $w^2$, made to fit them exactly in the chambers $M^1$ $M^2$. By these combined means the whole water which enters the valvular governor is constantly either being forced into the press cylinder or being discharged back into the supply cistern, and but little, if any of it, runs to waste.

The mode of working the press, and of the machinery connected therewith, is as follows:—The safety-valve V of the pumps (which acts of course equally as a safety-valve to the reservoir communicating with them,) is first loaded according to any degree of pressure desired to be transmitted to the press, and the pumps then set to work. When the whole of the water in the supply cistern H has been pumped into the reservoir, the air cocks, *q q q*, attached to the suction pipes, are opened, and the pumps continued to be worked, and air instead of water thereby thrown into the reservoir, until the safety-valve begins to rise, which is an evidence of the reservoir being in a fully charged state. The water-induction port is then opened by means of the double-ended lever O, on which the water is impelled with great force and rapidity up against the piston or follower of the press, owing partly to the elastic force of the air in the top of the reservoir acting on the water, and partly to the gravitation of the water itself, (the reservoir rising above the level of the cylinder of the press.) The instant the piston has performed its stroke, the lever O, is reversed, and the eduction port T, opened; and as soon as the first charge of water has passed away, the induction port is re-opened for a second charge, and so on through any number of charges and discharges. The pumps in the mean while continue working unintermittingly, returning the water *back* to the reservoir as fast as it comes from the press, and injecting along with it a portion of air, more or less, which makes up for any absorption of the air by the water in the reservoir, and thus keeps the reservoir in a state of constant efficiency. When the air seems from the action of the press to be injected in excess, it is only necessary to close more or less the air cocks, *q q q*. Each press must of course have a separate valvular governor, and separate sets of induction and eduction pipes, and a separate person to work it; but the number of presses which may be worked on this system by one set of pumps and one reservoir, is only limited by the respective capacities of the pumps and reservoir. In the figures, six presses are supposed to be worked by three pumps and one reservoir, but these are merely given as relative numbers, which are found convenient in practice. Instead also of dis-

tributing the power furnished by the reservoir over a number of presses, it may, if preferred, be concentrated on one. The lever O, too, may be worked with any degree of rapidity required, so that either a great pressure sustained through a considerable length of time, or a smaller pressure sustained during a shorter space, is equally attainable.

## EMPLOYMENT OF TURF OR PEAT AS FUEL FOR STEAM-ENGINES.

[From a paper on the "Artificial Preparation of Turf" By Robert Mallet, Esq., C.E., communicated to the Institution of Civil Engineers of Ireland.]

The most exaggerated statements have been made by some authorities, upon which reliance is placed, as to the evaporative power of turf, and hence of its value as fuel. "One pound of pure dry turf will evaporate six pounds of water," Doctor Kane says (Indus. Resources, p. 35,) on the authority of Peclet. However possible this may be, in experimenting with calorimetrical apparatus, certain it is, that the results of the most careful practice on the large scale fal immeasurably below it.

The City of Dublin Company's steamers on the Shannon are not "exclusively worked with turf." It is found impossible to keep up steam, especially in bad weather, without an admixture of coal; but I have been enabled, by a discussion of both fuels consumed in given times and distances, to arrive at this result—that it requires 51 lbs. of turf, of the best quality and dry, to boil off one cubic foot of water into steam, on the average; and that under the boilers of those vessels about 8 lbs. of good South Wales steam coal are equivalent to 48 lbs. of turf; so that, for equal weights, the turf is worth one-sixth of the coal. These results were obtained by me in the course of an inquiry, having in view the working of steam-boat boilers, on the locomotive construction, with turf, upon canals in Ireland. Experiments were made with care, in working with good dry turf, a locomotive boiler having the following dimensions:—

Fire-box, 3 ft. 3½ wide by 3 ft. 4 deep by 2 ft. long.
Grate, 3 ft. 3 by 2 ft. = 6½ square feet.
Tubes, 54 tubes—2½ in. diam. 6 ft. 9½ long.
Surface exposed in fire-box ..... = 40·89 square feet.
Surface exposed in tubes ..... = 240·04 square feet.

Total heating surface..... 280·93 square feet.

When this boiler fully supplied its engines with steam, at 60 lbs. pressure above the atmosphere, it consumed 114 lbs. of gas coke, in evaporating the same volume of water as was done by 868 lbs. of dry turf. This gives the value of turf to coke in this boiler in the ratio of 1 : 7·61, which is below that given in the boilers above alluded to on the Shannon.

The consumption was so rapid in the locomotive boiler that it was almost impossible to supply the fire, and maintain the draught.

The consumption of good dry turf, under a long cylindrical boiler, supplying a ten-horse high pressure engine, used in pumping water, and well set and arranged, erected under my own direction, was, on the average, 54 lbs. of turf for each cubic foot of water evaporated into steam, at 30 lbs. pressure, per square inch, above the atmosphere.

In a twenty-horse power condensing engine, erected under my direction, (by our firm,) with wagon boilers, which were already in existence, the consumption of tolerably good turf averaged from 57 lbs. to 60 lbs. for each cubic foot of water, evaporated into steam, of about 5 lbs. pressure above the atmosphere.

In a thirty-five horse power condensing engine, (Sheane and Beale's, Mountmellick,) the largest I have found worked with turf in Ireland, I found, last year, the consumption varied from 55 to as high as 80 lbs. of turf to the cubic foot of water, evaporated into steam, at about 7 lbs. above the atmospheric pressure. The boilers are well set, and the furnaces well calculated for burning turf, which, however, was not quite dry, (even to the hand,) and only moderately good in quality. Coal at 16s. per ton would have been quite as cheap; and if the turf were a little more damp, as in the winter time it would be, coal would be the cheaper fuel. If the turf had been quite dry, on the contrary, I calculated that the saving by its use, in place of coal at 16s. per ton, would amount to about 6s. per day, of twelve hou—

Blavier, Tredgold, Clement, and Desormes, all trustworthy and unbiassed authorities, give 53·6 lbs. of turf as the average amount to convert a cubic foot of water into steam; and as their results are quite confirmed by my own observations, I conceive it may be taken as a safe datum for practice, that a given weight of turf of the best quality, as usually now prepared in Ireland, will not, on the average, convert into steam more than its own weight of water. I believe, by proper preparation of the turf in cutting, and by complete drying in a kiln, that this result might be nearly doubled; but even so, the result would be only about one-third of the values assigned by Doctor Kane and Mr. C. W. Williams, whose statements, on this subject, are calculated to lead to much disappointment and loss.

### MR. GACHET'S DESIGN FOR A SCREW PROPELLER.

Sir,—I confess that I do not understand the description given by Mr. Gachet, of his experimental screw propeller, or of the one he proposes to construct, (No. 1165, p. 391-2,) but I very much doubt the success of his plan of working a screw propeller (*of any kind or shape*,) within a tube running from stem to stern of the vessel; for the friction of the water passing through a tube of this length would prevent any considerable velocity being gained by a vessel thus fitted. I am afraid your correspondent knows but little of ship-building, or seamanship, or he would not propose passing the ends of a tube of this diameter "*through* the stem and stern posts;" or suppose that the screw propeller, as at present fitted, can ever be rendered "quite inoperative in consequence of the force of the waves."

I am, Sir,
Your Old Subscriber,
T. W.

### ON THE DETERMINATION OF THE MELTING POINTS OF METALS AND VARIOUS METALLURGIC PRODUCTS AND OF THE TEMPERATURE REQUIRED FOR THE FORMATION OF DIFFERENT SILICATES. BY LEWIS D. B. GORDON, ESQ., REGIUS PROFESSOR OF CIVIL ENGINEERING AND MECHANICS, UNIVERSITY OF GLASGOW.

In reviewing the state of our knowledge of to ... The melting points of bodies, seven different ... of pyrometers that have been em- ... or proposed by experimenters were briefly mentioned, and it appeared that the many researches undertaken by philosophers with those instruments afford us only a *graduated scale of the fusibility* of the substances tried, and do not give *the absolute melting* points, save for a certain number of metals in their simple state.

Table No. I. gives the results of different experimenters, from which it appears how little, on the whole, had been done in this important subject until Plattner of Freyberg undertook a most elaborate series of experiments, of which, and of their results, it is the object of this paper to give some account.

Plattner was guided in his course of research by the methods of Prinsep and Daniell, but more especially by the method of de Saussure, for determining the melting points.

Saussure's method consisted in endeavouring to determine the fusing point of a substance in degrees of Wedgewood's pyrometer, according to the diameter of the greatest assay he could fuse before the blowpipe, by comparison with the diameter of the greatest globule of silver he could melt under circumstances in every respect the same, and the melting point of which he knew.

[The instruments employed, and method of experimenting adopted by Plattner for perfecting this notion of de Saussure, were exhibited and explained.]

For determining the melting points of the more easily fusible products, alloys of gold and silver, and silver and lead, (see Table II.,) were employed; and for those of the more refractory products, alloys of *gold and platinum* were used.

The determination of the melting point of *platinum* was a preliminary step, and this was ascertained by two experiments, as follows:—

1°. It was found that with a blowpipe supplied with air, under a gentle pressure, from a gasometer, a gold regulus weighing 2290 *milligrammes*, can be fused and maintained in fusion on charcoal, and in the same circumstances, an alloy of 1760 mill. gold + 230 mill. platinum can be maintained in fusion; and if either more gold, or a very small quantity of platinum, be added, the fusion is imperfect.

2°. An alloy of gold and platinum was found having the same melting point as *cast iron*, viz., 70 gold + 30 platinum fused in the same time as 100, by weight, of cast iron.

The melting point of platinum is deduced from these experiments to be—

From 1° 2529° C.
2° 2539° C. } Mean, 2534° C.

and these experiments appeared satisfactorily to warrant the assumption that *alloys of silver and gold*, and *gold and platinum, have melting points proportional to the melting points of each of these metals*; an assumption made by Prinsep.

Mitscherlich's determination of 1560° C. as the melting point of platinum was referred to, but as this involves all previous determinations of the melting points of other metals being erroneous, that is, much too high, Plattner was justified in assuming his own determination as the basis of the temperature given in Table II. and in his further researches.

The melting points of—

| | | |
|---|---|---|
| Lead being taken at | | 334° C. |
| Silver | — | 1023° C. |
| Gold | — | 1102° C. |
| Platinum | — | 2534° C. |

it was easy, according to the method described, to determine the melting points of the most refractory substances, so long as these were under that of platinum. The alloy being found having the same melting point as that of the body under research, its value was then—

$$s = \frac{A\,s + B\,s'}{100}$$

Where A and B are the weights, and s and s' the melting points of the metals contained in the alloys. And 100 parts by weight of alloy, and body under experiment, were taken respectively.

Attention was called to the circumstance that Daniell had fixed the melting point of copper at 1091° C., or under that of gold. Prinsep found, from constant experience as an assayer, that this is not the case, and fixed the melting point to be the same as that of an alloy of 97 parts of gold and 3 parts platinum. Plattner found 95 parts gold and 5 platinum to answer more exactly, and hence, applying the above formula,

$$s = \frac{95 \times 1102° + 5 \times 2534°}{100} = 1173°$$

the melting point of copper.

The second part of Plattner's researches *on the Determination of the Temperature necessary for the Formation of different Silicates*, was promised, should the society consider it of sufficient interest, as the subject of a future communication.

TABLE I.

*Tabular view of the Melting Points of Metals, as determined by different Experiments.*

| | | | | |
|---|---|---|---|---|
| Tin melts at | 228° | Centigrade, | according to | Crichton. |
| Do. do. | 267° | .... | .... | Guyton. |
| Do. do. | 228° | .... | .... | Rudberg. |
| Do. do. | 230° | .... | .... | Kupffer. |
| Do. do. | 222·5° | .... | .... | Ehrmann. |
| Bismuth do. | 246° | .... | .... | Crichton. |
| Do. do. | 241° | .... | .... | Guyton. |
| Do. do. | 265° | .... | .... | Rudberg. |
| Do. do. | 264° | .... | .... | Ehrmann. |
| Lead do. | 322°| .... | .... | Crichton. |
| Do. do. | 322·2° | .... | .... | Guyton. |
| Do. do. | 325° | .... | .... | Rudberg. |
| Do. do. | 334° | .... | .... | Kupffer. |
| Quicksilver boils at | 350° | .... | .... | Dulong and Petit. |
| Zink hardens *above* | 400° | .... | .... | Rudberg |
| Do. melts at | 411° | .... | .... | Daniell, measured with an *Iron Rod.* |
| Antimony do. | 512° | .... | .... | Guyton. |
| Silver melts at | 1023° | .... | .... | Daniell, measured with an *Iron Rod.* |
| Do. do. | 1034° | .... | .... | Guyton. |
| Do. do. | 999° | .... | .... | Prinsep. |
| 9 parts silver 1 part gold do. | 1048° | .... | .... | do. |
| 3 do. 1 do. do. | 1121° | .... | .... | do. |
| Copper 1132° C. corrected to | 1091° | .... | .... | Daniell, with Platinum rod. |
| Do. melts at | 1207° | .... | .... | Guyton. |
| Do. do. | 1173° | .... | .... | Plattner. |
| Gold, 1144° corrected to | 1102° | .... | .... | Daniell. |
| Do. melts at | 1163° | .... | .... | Do. with *Iron Rod.* |
| Do. do. | 1380° | .... | .... | Guyton. |
| Cast Iron, 1587° corrected to | 1530° | .... | .... | Daniel, with Platinum rod |
| Platinum melts at | 2534° | .... | .... | Plattner. |

TABLE II.

*Melting Points of various Metallurgic Products.*

| Name of the substance, the melting point of which is determined. | 100 by weight of this substance melt in the same temperature and in the same time to a globule as alloys of | | | Melting point deduced by calculation. |
|---|---|---|---|---|
| 1. Sulphuretted metals, from process termed *Roharbeit* | 30 Gold | + 70 Silver | | = 1047°C. |
| 2. Do. Lead process | 5 — | + 95 — | | = 1027° |
| 3. Do. Copper do. | 3 Lead | + 97 — | | = 1002° |
| 4. Arseniuretted Metals, Lead | 50 Gold | + 50 — | | = 1062° |
| 5. Raw Copper | 5 — | + 95 — | | = 1027° |
| 6. Red Litharge | 90 Silver | + 10 Lead | | = 954° |
| 7. Slags :— | | | | |
| a. Greenish yellow colour, and slight glass vitreous lustre | 8 Gold | + 16 Platinum | | = 1331° |
| b. Dark grey, slight vitreous lustre | 82 — | + 18 — | | = 1360° |
| c. Light grey colour, slight vitreous lustre, (hot blast) | 83 — | + 17 — | | = 1345° |
| d. Dark grey vitreous lustre, slight, (hot blast) | 82 — | + 18 — | | = 1360° |
| e. Dark grey, vitreous lustre | 83 — | + 17 — | | = 1345° |
| f. Grey and blue striped, and vitreous fracture | 84 — | + 16 — | | = 1331° |
| g. Dark grey, slight vitreous lustre | 83 — | + 17 — | | = 1345° |
| h. Same, hot blast | 83 — | + 17 — | | = 1345° |
| Copper slags, raw metal | 83 — | + 17 — | | = 1345° |
| Tin slags, pure, Block, vitreous lustre | 85 — | + 15 — | | = 1317° |
| Iron slag, blast furnace, going on No. 4 iron, slags, greenish coloured vitreous fracture | 80 — | + 20 — | | = 1388° |
| Iron slag, puddling, Iron, black colour, metallic lustre, slight | 77 — | + 23 — | | = 1431° |

*Trans. Phil. Soc. Glasgow.*

ON THE MEASURE OF IMPACT, BY PRESSURE OR WEIGHT. BY PROFESSOR L. GORDON.

The object of this note was to point out that some recent attempts to measure the force of impact absolutely by the registered indication of a spring dynamometer, would give only comparative results, varying for each particular spring used.

Supposing the spring's elasticity to be such, that equal pressure produced equal elongations, it was demonstrated that its registration under the influence of a weight suddenly brought upon the dynamometer, and its acquired velocity, would be double the elongation due to the weight, supposing all acceleration of motion carefully prevented.

If the weight be let fall from a certain height, elongating the spring by impact, it was shown that registered elongation, or maximum elongation would exceed that due to the weight W, by a quantity equal to a mean proportional between this elongation, and the same increased by double the height fallen through. This latter mean is the direct measure of the influence of the inertia of W, or its momentum, the mechanical effect accumulated in the dynamometer spring.—*Trans. Phil. Soc. Glasgow.*

MAGNETISM.—ANOTHER IMPORTANT DISCOVERY.

The phenomena of magnetism have been attracting the attention of scientific men for some time past; and it appears, from the results of their investigations, as if we were advancing to a knowledge of many of the more secret operations of nature. A very interesting discovery has been recently made by Mr. Robert Hunt. By placing a glass trough on the poles of a powerful magnet, and filling it with any fluid from which a precipitate is slowly forming, it is found that the precipitate arranges itself in the magnetic curves. Crystallization, taking place under the same circumstances, exhibits

also the influence of magnetism on their molecular arrangements—all the crystals heading and arranging themselves in the order of the magnetic curves. The experiment is very beautifully shown by filling the trough with a solution of nitrate of silver, and placing a globule of mercury on the glass, equidistant from the poles of the magnet:—the revived silver shoots out in all directions, in a very pleasing arborescent form; but it maintains in a striking manner the curvilinear tendency, and distinctly marks out the lines of magnetic direction. It would appear, from the results already obtained by Mr. Hunt, that this influence is universal.—*Athenæum.*

### IMPROVEMENTS IN LIGHTING—THE DRUMMOND LIGHT, FRESNEL LENSES, STEVENSON'S TOTALLY REFLECTING ZONES, FARADAY'S VENTILATING TUBES, ETC.

[From Statement by Alan Stevenson, Esq., engineer, to the Commissioners of the Northern Light Houses, laid before the Select Committee on Light Houses, 1845.]

In so far as *the source of the light* is concerned, I cannot say that any very great improvement has been effected since the time of the former enquiry by the Parliamentary Committee in 1834. Spermaceti oil is still employed in all the Northern Lights. No success has attended any attempt to render the Drummond Light, which was at that time a subject of so many experiments, at all applicable to lighthouse purposes; nor am I aware that any one has even indicated the direction in which enquiry might with the greatest chance of success be employed. All the changes that have been proposed have consisted in burning various gases under certain modifying circumstances; but I see no reason for believing that an increase of intensity sufficient to warrant the introduction of gas into Lighthouses has been obtained. Its use is unquestionably attended with risk of irregular exhibition in situations so remote as most lighthouses are, and in some situations it is wholly inapplicable, (as in the Bell Rock and Skerryvore,) and also in all revolving lights on the reflecting principle. In ordinary weather the present lights are seen as far as the curvature of the earth allows; and unless a light powerful enough for the penetration of fog can be found, I see no inducement to run any risk as to the due and regular exhibition of the light, for the sake of any small increase of its intensity. Some smaller changes have been introduced in regard to the lamps, which have been useful. The ventilation, which in the Scottish lights, however, has always been very good, has lately received some further improvement from the introduction of a careful mode which I have adopted for manufacturing the glass chimneys of the dioptric lights, which are now blown in a metallic mould, so as to give them a more perfect and invariable form, an element of the greatest importance in securing a proper combustion. Ventilating tubes have long been used in the Scotch lights, and I have lately extended their use to the dioptric burners, for which a tube similar to that lately described by Dr. Faraday has been used.* By these means the flame has been increased in volume, and also in brilliancy of effect, but the consumption of oil has been raised nearly one-fifth. Besides increase of intensity of light, I should say that at present a great desideratum, in regard to dioptric lights at least, is an increased horizontal diameter of flame capable of producing greater divergence of the resultant beam, and consequently longer flashes and shorter intervals of darkness in the revolving lights. For this purpose I have tried a lamp with five wicks instead of four, as in those now

* "Will you explain the nature of that improvement?—The improvement in the reflecting lights consists in fixing over each burner an air-tube; these several tubes meet in a common tube which has external communication; they are a little curved at the lower part, where they enter the glass cylinder or chimney, and are placed at about the eighth of an inch below the upper edge of that chimney, and it is found by this adjustment that a current of air is produced, running in the first instance down into the chimney, and then immediately after altering its course and passing up the tube, is ultimately carried out; so that the vapour produced by the combustion of the oil, which is not only injurious to the light when condensed upon the glass, but is also prejudicial to the human frame, is carried away, and the light-keepers state, in those lanterns where it has been placed, that they can live in and endure the heat of the lantern, which is greatly lessened, without any sort of inconvenience, so greatly is the circulation of pure air promoted by this apparatus."—*Evidence of Mr. Jacob Herbert Secretary to the Trinity Board.*

in use; but the consumption of oil is very much greater, perhaps almost one-third more. The maintenance of the present lamp for dioptric lights, which has four concentric wicks, costs for oil alone about 210*l.* per annum.

In *the means employed* for modifying the direction of the light, so as to economize it and apply it to the best advantage, the perfection of the optical instruments has effected substantial improvements. The great lenses of Fresnel used in *revolving* lights, have received a considerable extension of surface, and are now much more perfect in the adaptation of their parts, the finer polish of the surface, and in the more homogeneous and colourless material, all of which circumstances have combined to raise their power fully one-fourth. The refracting belts employed in *fixed* lights have not only partaken of the same kind of improvement as the lenses, but in the case of the Isle of May Light, which was changed to the dioptric plan in 1836, I suggested a change in the form of these refractors, whereby the distribution of the light is equalised over all the horizon, and which I am happy to say has since been adopted in France. Lastly, the fixed lights have received a further and most important improvement in consequence of a suggestion made by me, which consists in applying totally reflecting zones in the room of the curved mirrors hitherto used for the purpose of intercepting the light which passes above and below the central or principal part of the apparatus.* The French glass has of late been so much improved at St. Gobin and Prémontré, that it may admit of zones of larger cross section than I had contemplated, and some improvements in the form which I had considered almost unattainable have been undertaken on the suggestion of M. Leonor Fresnel, by M. François, an

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* *Chairman.*—"Will you explain the nature of a dioptric fixed apparatus?—The apparatus consists of several parts, of which the principal is a central or equatorial band of glass. The action of this instrument is not to collect the light from the sides, but simply from the top and bottom, or in a vertical direction. Its effect is to render the light parallel to the horizon, so that the rays are thrown out in the form of a flat ring, equally intense in every azimuth. The depth of this band is limited by its distance from the focus, because the highest and lowest ray proceeding from the lamp must not make at the inner surface more than a certain angle, otherwise, instead of proceeding through the refractor, it would be reflected backwards and lost. In order therefore to save the light which passes above and below this ring, the former practice was to use a set of curved mirrors of looking-glass, each of which had its focus in the lamp. The loss of light from these mirrors being considerable, I proposed to replace them by *totally reflecting* zones, on the principle of the small apparatus invented by the late French academician, Augustin Fresnel. The upper zones encompass the flame in the form of a bee-hive roof, and the lower ones are arranged in a cylinder; their effect is to intercept the light which would otherwise be lost: the light falls upon the inner surface of these zones, which are three-sided prisms. At this first or inner surface of each zone, the light is *refracted* so as to pass on to the second side of the prism, which it meets at a certain angle in such a manner as not to pass through that side, but to be *totally reflected* from it; after this *total reflection* at the second side of the prism, the light proceeds to the third or outer side, at which it suffers a second *refraction*, and then emerges horizontally.

"How many of these lights have been established in Scotland?—There is not one in this form yet established anywhere, but it will be used at the Covesea Skerries; the light at Isle of May has an equatorial band; but it is not perfect; and since the Isle of May apparatus was made, I have devised an arrangement for putting the junctions of the zones in this inclined form, so that no part of the horizon appears dark.

"The circle appears to be made of diagonal pieces?—Yes; each portion of the ring is a part of a helix, cut off by horizontal planes.

"What advantage have you from that?—You have the advantage of not intercepting the whole of the light in any one direction; the quantity of light intercepted is merely a small portion of the bar, proportioned to the cosine of inclination. In this case the small portion of light intercepted in the diagonal subdivision is so small as not perceptibly to affect the efficiency of the light.

"So that out of a hundred rays, one ray only strikes upon the joint?—Yes, that may serve as a popular illustration of the effect."—*Mr. Stevenson's Evidence.*

artist of Paris. M. Fresnel computed a new series of zones with all these improvements, which I also jointly computed as a verification. The work has since been executed by M. François, in a manner which exceeded our best expectations. The series of zones, therefore, now consists of 19 large zones, instead of 24, and 46 of the smaller size, as I originally intended; and so great has been the improvement of the glass, that little or no loss of light has, I believe, been sustained by the adoption of the larger sizes, while the manufacture has been greatly facilitated by the additional strength of the glass. This substitution of zones for mirrors, in so far as my experiments enable me to judge, seems to have increased the light derived from the subsidiary part of the apparatus by about one-third. I cannot doubt that the fixed dioptric lights of this country, in so far as the modifying apparatus is concerned, are nearly perfect. About nine-tenths* of the whole sphere of light are rendered available; and the only great improvement of which these lights seem now to be susceptible must be sought for in an increase of the intensity of the light itself. In the revolving lights, on the contrary, (besides the desirableness of greater intensity,) the defect of short flashes and long eclipses calls for some increase in the volume of the flame, or some change in the form of the instrument. In regard to the fixed lights I may further observe, that some attempts were made to increase their brilliancy by the late Captain Basil Hall, R.N., who conceived the idea of producing a continuous light, and consequently the appearance caused by a fixed light, by means of a light in rapid revolution. On his suggestion I made a train of experiments under the authority of the Commissioners of Northern Lights, with the view of testing his plan; but the result, which I have described in a communication to the Royal Society of Edinburgh, showed that before continuity of effect could be obtained, a rapidity of motion was required so great as to render the light incapable of affecting the retina.

Another very important object in regard to the mode of illumination, and one in which, I regret to say, no late improvement has been made, is an extension of the means for distinguishing one light from another. The distinctions at present are nine in number; viz., fixed, revolving white, revolving red and white, revolving red with two whites, revolving white with two reds, flashing, intermittent, double fixed lights, double revolving white lights. In France all the distinctions are produced by variations in the time of the flashes; but these differences seem too minute for a seaman in a stormy night, and changes in appearances which more immediately affect the eye, are, I think, more desirable, as affording a more direct means of arresting attention. So far as I know, no colour but red will be found to answer the purposes of a light, as well on account of the enormous loss of light, which their production involves, as of the want of a decided character which all other colours fail to give to a distant observer at night. Chemists may probably find new means of varying the colours of lights not liable to such objections.

* In fixed lights, on the catoptric principle, only two-thirds of the light are available.

### PROPERTIES OF STEAM.

A new and very extensive series of experiments has been lately made in France, by authority of the Minister of Public Works, under the superintendence of M. Regnault, to ascertain the elastic powers of steam, at different temperatures and pressures. The subject, as our readers are aware, has already occupied the attention of many distinguished men, among whom the most deserving of notice are, Gay Lussac, Dulong, and Arago, in France; and Watt, Dalton, Robinson, and Ure, in our own country.

The questions to be determined by M. Regnault, were—1. The law which unites the temperatures and elastic powers of aqueous vapour at saturation. 2. The quantity of heat absorbed by a kilogramme of water at 0 degree, to be converted into steam for saturation at different degrees of pressure. 3. The quantity of heat absorbed by the same quantity of water in order to raise the temperature to the point in which it assumes the state of vapour under different pressures. 4. The specific heat of aqueous vapour at different stages of density, and at different degrees of temperature. And 5. The co-efficients of dilation of aqueous vapour in different stages of density. M. Regnault repeated the results of his

researches to the Paris Academy of Sciences, on the 15th ult. In these results he agrees most with MM. Dulong and Arago, particularly as regards high rates of pressure. Watt had supposed that the total quantity of heat necessary for the transformation of a kilogramme of water into the state of steam was certain under a constant pressure. The number admitted was 650. This law, although not exemplified by any precise experiment, had been till very lately regarded as positive, and so adopted in theory and practice. M. Regnault, however, has ascertained that this number increases constantly from 622, under the pressure of one-fifth of an atmosphere, up to 670 under 15 atmospheres. At the ordinary pressure the average of 38 experiments gives 636·37. As to the calorific capacity of water it is 1,000 between 0 and 30 degrees, 1,005 between 30 and 120, 1,013 between 120 and 190.

CARSON'S DIRECT STEAM VACUUM APPARATUS.—MR. DIRCKS IN REPLY TO MR. MALLET.

Sir,—I only read this evening Mr. Mallet's letter in your Number for December 13, in reference to my paper of November 29, or I should have replied earlier. I regret to find him resorting to the common subterfuge employed by those who have a weak cause to support, of speaking of persons in a manner of no very questionable meaning, as when he talks of "some Mr. Carson," designates myself "one Mr. Dircks," and ventures a sneer at my "*professional*" engagements. And not content with this unfair means of attempting to carry his point, having recourse to the most flagrant misstatements of the design and object of the paper in question, by saying that I "try to show that some Mr. Carson is the meritorious first inventor of direct steam vacuum *for use upon atmospheric railways*," and again repeating the same erroneous statements.

I deny the imputation, and am sure that Mr. Mallet himself, on a more careful perusal of my communication, will find how much he has wronged me. Mr. Mallet says, that I raise no question as to his "being an independent inventor." Certainly not, for I consider him independent of all rule and precedent. He no doubt feels aggrieved that I should make such small account of his assumed invention, one based on Mr. Carson's patent, and not brought to light until after Mr. Nasmyth had re-patented Mr. Carson's apparatus "for withdrawing air and vapour." His joke about "the pains of parturition of this invention," applies with lively force to the august manner in which his own MSS. relating to his scheme were brought forth. How he could ever suppose that the public would receive such evidence, as a publication sufficient to establish priority of claim to an invention, I cannot imagine; but from his arguments in the discussion that then took place, and the character of his present letter, it is evident he is pregnant with strange ideas. His letter I take to be an attempted argument in favour of Mr. Nasmyth's right to his patent claims, in the adoption of Mr. Carson's direct steam vacuum apparatus, a species of *invention* now very common. I had already stated the obvious character of employing a direct steam vacuum; I cannot exactly understand Mr. Mallet's reason for so learnedly discoursing about Savery, Leslie's plan, and others, "proposed, printed, and applied." Is this meant to enlighten us that a *principle* is not a fitting subject for a patent? If so, it is wide apart from the argument; for Mr. Carson claims only for a particular apparatus, obtaining a vacuum therein by steam, and applying it to flues, mines, and other useful purposes generally. Mr. Mallet (himself a patentee) is too well acquainted with patents, I have no doubt, to have been wholly ignorant of Mr. Carson's patent in 1840, but having found it, though a useful stepping-stone, yet now rather in his way, he would fain appear to soar far above the limited views (as he would have them to be) of "some Mr. Carson," a gentleman whom I have long known, and highly esteem.

If Mr. Mallet can so deliberately state Mr. Carson's case broadly different to facts, he should be the last to accuse others of "garbled quotations;" however, the patent is before your readers, and it is very clear, I consider, that Mr. Carson's claims for the uses of his apparatus, figured as No. 8, are as comprehensive as general terms will admit; otherwise, instead of an ordinary specification, patents should have appended to them a complete catalogue of all possible applications. I grant that some patentees have confined their claims to a particular use, and have so lost all other applications; but why deal with such possible cases, which are a great aid to the appropriation of other men's ingenious inventions, when we have a plain matter of fact before us, as in the case of Mr. Carson's claims? Mr. Nasmyth has done no more than employ Mr. Carson's apparatus, and the leading point in my paper is to prove *that* appropriation.

Mr. Mallet, as it appears to me, has taken very needless umbrage at my having "stumbled upon this mare's nest of Mr. Carson's," in respect to which he petulantly remarks,

"He (H. D.) has so fussily busied himself, with no other result but to show the public how little he has to do, and how incapable he is of deciphering (?) the claims of a patent, or determining the rights of an inventor;" or perhaps he only meant an *approbator*. How far I have shown the weakness attributed to me by your correspondent, I shall not trouble myself about considering; all I hope is, that your readers will at least concede to me the merit of having written in better temper, with fuller proofs, and more sound argument, than Mr. Mallet has exhibited on the present occasion.

I am, Sir,
Your obedient Servant,
H. DIRCKS.

7, Nicholas-lane, City,
Dec. 27th, 1845.

THE STEAM PRACTICE OF THE ROYAL NAVY.—NOTE ON COMMANDER HOSEASON'S LAST LETTER.

Sir,—It appears unnecessary and superfluous to make any lengthy remarks upon Mr. Hoseason's letter, published in No. 1168. Surely, discomfiture never was more apparent, or he would have attempted some sort of answer to my strictures, and not have confined himself to coarse abuse, and a most scandalous imputation upon their supposed author. There can be no doubt that honour compels him to substantiate his assertion to the fullest extent—failing which, your readers will know how to estimate his conduct.

Although amusingly in error as to my identity, most of your professional readers will know to whom he has alluded. There can be no mistake in this, because, the Parliamentary return referred to, was of the most partial and incomplete nature, intentionally designed to support one sort of construction, and the engines of one manufacturing firm; and to disparage the principle, and damage the reputation of those of another firm. A perusal of this document, (published in Number 1138,) and of the trade pamphlet or circular of Mr. Alexander Gordon, will explain and prove the truth of this.

I have written anonymously,—having *nothing to gain* by printing my name in your pages. I neither desire nor require to obtain professional advancement by such means, and do not think your readers now require any farther evidence on my part to correctly fix the courteous appellation of "blockhead;" but of this Mr. Hoseason may rest assured, that his castigation had just as much effect upon me, as his bellicose threats now have. I treat both with profound indifference.

I may be allowed to add, that Mr. Hoseason is perfectly unknown to me. In descanting upon his letters, I have been actuated by one motive—duty to my profession, and (as an old reader of this Magazine) to yourself—to prevent the dissemination of unsound doctrine and reasoning by means of its pages. How far I have succeeded will be decided by competent judges.

I have done,—*parcere subjectis!*

Your obedient Servant,
PRESSURE NOT PUFF.

London, Dec. 30, 1845.

PREVENTION OF BOILER PRIMING.

Sir,—In answer to "W. H.'s" letter in No. 1167, describing his boiler, and requesting suggestions for preventing it from priming, I beg to state, that it is, I believe, well known that the most effectual method is to give more steam room. From the construction of his boiler, it is evident that he cannot work the water low enough to give that steam room, without burning his tubes, and throwing away his heating surface; therefore, his best plan will be to put a steam-chest on the boiler, and to take the steam-pipe from the top of it. In a small non-condensing engine I know, with a 6 in. cylinder, and a horizontal tubular boiler, there was much trouble experienced from priming; but it has been effectually cured by putting a steam-chest over the boiler, which is only connected thereto by a short pipe, about 2 in. diameter. The steam-pipe remains attached to the top of the boiler: of course it would be better if it were taken from the top of the steam-chest. If there is sufficient room on the top of the boiler, the best form for the steam-chest would be that of a short cylinder, with a hemispherical top, as is seen in locomotives—the communication between it and the boiler being made by a number of holes in the top of the boiler. I should say that 10 inches diameter, and 18 height, would be a sufficient size for the steam-chest. I have never seen a trial made of lime, tallow, &c., as mentioned by "W. H." but I may mention, as an instance of the advantage of keeping the water as free from all other matters as possible, that in going down the river, in a small river steam-packet, the (tubular) boiler, which primes very much in the dirty Thames water, ceased

priming altogether when we got into the sea, and *vice versâ* in returning. This boiler worked with 15 lbs. to the inch, and supplied just enough steam, but not without pretty hard firing, to a pair of 27 in. cylinders, working without expansion, and the pistons moving 210 ft. per minute.

I am, Sir, your obedient servant, and always a sufferer from muddy water,

SLIDEVALVE-FACE.

HOW TO MAKE GOOD TRACING PAPER.

Sir,—Would you be so obliging as to inform me of a good recipe for making tracing paper? I have tried various mixtures, but find none of them answer very well. The last I tried was four parts nut oil to five parts turpentine, and then washing with ox-gall. It looked pretty enough till washed with the gall, which makes it rough and spoils it. I have also tried the balsams and drying-oil, but without much success. I am aware of a recipe being in your Magazine of an old date, but since then I understand the process to be much improved. The French are said, I believe, to make the best tracing paper. This article is at present in great demand, and I would consider it very kind if you would favour me in your next with any information on the subject.

I am, Sir,

Your most obdt. servant,

P. M.

24th Dec. 1845.

*Recipe.*—Mix six parts (by weight) of spirits of turpentine, one of rosin, and one of boiled nut oil, and lay on with a brush or sponge. We find this produces a tracing paper that leaves nothing to be desired.—ED. M. M.

THE EXPERIMENTAL STEAM SQUADRON.

We have been favoured by a correspondent with the following, as a more complete list of this squadron, their tonnage, horse-power, &c., than that given in our last volume, p. 429.—ED. M. M.

| *Ships.* | *Tons.* | *Designer.* | *H. P.* | *Descrip. of Engine.* | *Engineers.* |
|---|---|---|---|---|---|
| Tarrible .... | 1849 .. | Lang .. | 800 .. | } Double cylinder .. | Maudslay & Co. |
| Retribution . | 1641 .. | Symonds .. | 800 .. | | |
| Avenger .... | 1444 .. | — .. | 650 .. | Gorgon .. | Seaward & Co. |
| Gladiator .. | 1190 .. | — .. | 430 .. | — .. | Miller & Co. |
| Samson .... | 1297 .. | — .. | 450 .. | — .. | Rennies. |
| Ardent .... | 800 .. | — .. | 200 .. | — .. | — |
| Rattler .... | 888 .. | — .. | 200 .. | } Double cylinder .. | Maudslay & Co. |
| Scourge .... | 1124 .. | — .. | 420 .. | | |
| Black Eagle . | 540* .. | Lang .. | 260 .. | Oscillating .. | Penn. |

THE ATMOSPHERIC RAILWAY SYSTEM.

Sir,—It is sufficiently well known to the scientific world that the inventor and patentee of the longitudinal valve, which rendered the principle of atmospheric traction on railroads practicable, was Mr. Samuel Clegg. But statements have appeared since the lamented death of Mr. Jacob Samuda, which might leave even the best informed in doubt. To you, therefore, Sir, as conductor of the chief publication relating to scientific matters, I address this, begging that you will rectify the error of those who have, of course, inadvertently stated the inventor and patentee to be Mr. Samuda. Much, very much is due to the memory of that talented gentleman in bringing this invention forward, but surely we must not neglect the living in doing honour to the dead.

Allow me to remain, Sir,

Your obedient servant,

G. G.

[An impression that the late Mr. Jacob Samuda was conjoined with Mr. Clegg in the patent, does prevail to an extent sufficient to justify the anxiety of our correspondent to have it rectified. So much is this the case, that in the Appendix to Mr. Mallet's reports on Atmospheric Railways, (Weale's Quarterly Papers, 1845,) there is given what is professed to be a copy of the specification of this patent, which thus commences:—"To all whom it may concern, be it known that WE, Samuel Clegg, of Sidmouth-street, Gray's Inn-lane, and Jacob Samuda, of Southwark, C.E., *have* invented and discovered," &c. *Whoever supplied* Mr. Mallet with the copy in these terms, must have known it to be false and spurious. No specification containing such words ever existed. The patent and specification were both in the name of Mr. Clegg alone. —ED. M. M.]

* 495 was her tonnage before she was lengthened, 1844.

## LIST OF ENGLISH PATENTS GRANTED BETWEEN NOVEMBER 27, AND DECEMBER 24, 1845. (CONCLUDED FROM VOL. XLII. P. 449.)

Henry Pershouse, of Birmingham, manufacturer, for a certain improvement or certain improvements in apparatus used in connection with writing, and also in attaching postage stamps and labels. December 23; six months.

John Penn, of Greenwich, engineer, William Hartree, the younger, of Greenwich, aforesaid, engineer, and John Matthew, the younger, of Greenwich, aforesaid, engineer, for certain improvements in steam engines and machinery for propelling vessels, which improvements are also applicable for other purposes. December 23; six months.

William Cole, of Coventry, warehouseman, for certain improvements in looms. December 23; six months.

## LIST OF PATENTS GRANTED FOR SCOTLAND, FROM THE 20TH OF NOVEMBER TO THE 18TH OF DECEMBER, 1845.

Robert Hazard, of Clifton, near Bristol, Somerset, confectioner, for improvements in apparatus for heating public and private buildings. Nov. 26.

Edward Augustin King, of Warwick-street, Middlesex, gent., for improvements in obtaining light by electricity. (Being a communication from abroad.) November 26.

Richard Archibald Brooman, of the Patent Office, 166, Fleet-street, London, gent., for certain improvements in weaving machinery. (Being a communication from abroad.) November 26.

Henry Clark, of Redcross-street, Cripplegate, London, oil-merchant, and George Roberts, of Wells-street, Cripplegate aforesaid, miner, for certain improvements in the construction of lamps, and in the preparation of materials to be employed for producing illumination. December 1.

Richard Archibald Brooman, of the Patent Office, 166, Fleet-street, London, gent., for certain improvements in dyeing. (Being a communication from abroad.) December 1.

Henry Buckworth Powell, of Pennington House, Southampton, lieutenant and captain in the Grenadier Guards, for certain improvements in carriages to be used on rail and other roads. December 1.

William Corsceden Thompson, of Liverpool, Lancaster, master-mariner, for certain improvements in machinery or apparatus for propelling vessels on water. (Being a communication from abroad.) December 2.

William Johnson, of Farnworth, near Bolton, Lancaster, agent, for certain improvements in machinery or apparatus for preparing cotton and other fibrous substances, for spinning. December 3.

William Newton, 66, Chancery-lane, Middlesex, civil engineer, for improvements in manufacturing types, and other similar raised surfaces for printing. (Being a communication from abroad.) December 3.

Earnest Edge, of Manchester, Lancaster, mechanic, for certain improvements applicable to the wheels and axles of engines, tenders, carriages, and wagons, to be used upon railways. December 4.

Thomas Findler, of Glasgow, Scotland, flint-miller, for a new invention or improvements in the construction and operation of certain parts of flint-grinding mills or machinery for grinding. Dec. 4.

John Constable, London, merchant, for improvements in the manufacture of gas for lighting and heating. (Being a communication from abroad.) December 4.

Peter Spence, of Burgh, Cumberland, chemist, for improvements in the manufacture of copperas and alum. December 4.

Nathaniel Chappell, of Arcadian Villa, Cumberland-road, Bristol, gent., for improvements in the manufacture of worts. December 4.

William Henson, of Skinner-street, Saint John-street-road, Middlesex, civil engineer, for improvements in machinery for weaving. December 6.

John Blyth, of Limehouse, Middlesex, engineer, for certain improvements for diminishing the risk of accidental explosions of gunpowder, and other substances which are liable to explode or ignite by contact with fire. December 5.

James Bounsall, of the Patent Office, 166, Fleet-street, London, for certain improvements in the preparation of resin and resinous-like substances, one or more, and certain new applications thereof to manufacturing purposes. (Being a communication from abroad.) December 6.

Thomas Henry Russell, of Wednesbury, Stafford, tube manufacturer, for improvements in the manufacture of welded-iron tubes. December 8.

Moses Poole, of London, gentleman, for improvements in the construction of vessels to contain liquids and substances, and in the means of impregnating liquids with gases, and in drawing off such liquids from such vessels, and enclosing such vessels. (Being a communication from abroad.) December 8.

Moses Poole, London, gent., for improvements in filling bottles and other vessels, and also in covering, stopping, or securing liquids and other matters in bottles and other vessels. (Being a communication from abroad.) December 8.

William Mushet and Robert Mushet, iron-founders, both of Dalkeith, for improvements in moulding iron. December 9.

John Dearman Dunnicliff, of Nottingham, lace manufacturer, and William Bull Dexter, of the same place, lace-maker, for improvements in the manufacture of warp fabrics. December 9.

Samuel Childs, of Earl's-court-road, Kensington, Middlesex, candle-manufacturer and wax-chandler, for improvements in the manufacture of candles. December 10.

Wilton George Turner, of Gateshead, Durham, doctor in philosophy, for an improved mode of treating guano for the purpose of obtaining chemical compounds therefrom. December 10.

William M'Naught, 26, Robertson-street, Glasgow, Scotland, engineer, for certain improvements in the steam-engine. December 11.

Christopher Binks, of Friar's Goose House, Durham, chemist, for certain improvements in manufacturing, and in the application of certain compounds, of nitrogen, particularly cyanogen, ammonia, and their compounds, and in the application in such manufactures of a substance or substances not hitherto so employed. December 12.

Robert Kerr, of Thread-street, Paisley, and of Renfrew, Scotland, manufacturer, for improvements in handloom weaving, and for producing a double fabric of raised figured work in the same loom, by one process of weaving. December 12.

Samuel Cunliffe Lister, of Manningham, near Bradford, York, manufacturer, for improvements in preparing and combing wool. December 15.

Henry Blumberg, of Camberwell-grove, Surrey, distiller, for improvements in the purification of spirits, for the use of brewing distillers and rectifiers. December 16.

Thomas Clarke, of Hackney, Middlesex, engineer, and John Varley of Poplar, Middlesex, engineer, for improvements in railways and other carriage ways, in propelling, and in engines, carriages and other machinery employed in propelling. December 17.

John Penn, of Greenwich, Kent, engineer and manufacturer of steam-engines; William Hartree the younger, of Greenwich, aforesaid, engineer, and John Matthew the younger, of Greenwich aforesaid, engineer, for certain improvements in steam-engines and machinery for propelling vessels, which improvements are also applicable for other purposes. December 18.

### NOTES AND NOTICES.

*Discovery of a New Planet.*—On the 13th of December, Mr. Hencke, of Driesen, gave notice that he had found a star of the ninth magnitude, near to the planet Vesta, in a place where before there was none. Professor Encke, of Berlin, has since verified this discovery, and considers the star to be a new planet near its opposition. Astronomers have agreed to call it *Astræa*.

*The Screw Steamer Massachusetts* seems to have met with bad weather and some mishaps on her return voyage to America. This vessel, it will be remembered, sailed from Liverpool, on the 22nd of October. She was obliged to put into Holmes' Hole, the place to which the *Great Britain* ran. In passing over the shoals coming out from this place, the *Massachusetts* took the ground, but after throwing overboard about fifty bags of salt, she got off. She, however, according to the accounts, got ashore again two miles to the eastward of Holmes' Hole, or Squash Meadow Shoals, and after discharging into lighters, was got off without damage. She had 100 passengers, all of whom arrived safely at Boston on the 20th Nov. Her commander is reported as being ill, and that the vessel was in charge of Mr. Forbes, the owner, who happened to be a passenger on board.

*The "Satisfactory" Janus.*—The *Janus* steam-sloop, after having swarms of artizans belonging to the dockyard employed making new alterations on board her for the last three weeks, had her steam up on Saturday, (December 13,) in order to try her engines alongside the sheer hulk, when the wheels revolved at the rate of seven turns per minute. She was again tried on Monday with no better success; and, on Tuesday, the 16th inst., at half-past 1 p.m., she left her moorings for another experimental trip, having on board Captain W. H. Sheriff, R.N., Captain-Superintendent of the dockyard, accompanied by the Earl of Dundonald, the constructor of the engines, and manned by seamen from the *Poictiers*, ordinary guard ship, it is stated, for Portsmouth, the *Janus* being accompanied by the *Comet* steam-vessel. The *Janus* had her jib-sail up and foresail, but notwithstanding she had a strong wind in her favour, her speed was no better than on her former trials.—*Times.* The *Janus* subsequently returned to Chatham, not having been able to accomplish the passage round to Portsmouth, and an order has been since finally issued, for the removal of the engines from the vessel.

*Fifteen steam-boats make a mile:* this is a new rule of arithmetic, only found out in America, and I mention it because it is much more easy than to remember that the steamers on the north and east rivers are 350 fee long each. In these moving palaces, which go twice a-day to Albany, 150 miles, as far as Margate and back again, I paid two shillings, but I might have gone the same day for one shilling, by another boat not quite so new and splendid. Only think, to Margate and back for one shilling!—*Rubio's Rambles in the United States and Canada.*

*Perpetual Motion.*—We were invited a few days ago to examine Colonel Boone's attempt to solve this long-sought problem. Our examination was somewhat cursory, but sufficient to satisfy us that he has invented a machine which will move until some of its parts are worn out by friction and the chemical elements of the atmosphere. The source from which the motive power is derived, is found in the great expansiveness and of course contractibil ty of refined spermaceti-oil, which in these qualities is four and a half times greater than mercury. The oil is placed in a metallic globe, from which it rises or sinks in a steel tube; into this tube again is fitted a steel cylinder that ascends or falls with the liquid. With this cylinder are connected the weights and blocks that regulate the uniformity of the motion.—*Maysville* (America) *Eagle.*

*Trade Marks.*—The American papers contain a legal decision, by Vice-Chancellor Sandford, on the subject of trade marks, that is of some importance to British manufacturers. Messrs. J. and P. Coates, of Paisley, in Scotland, had obtained an extensive market in America for a certain description of cotton thread. This thread had been imitated even to the labels by one M'Gregor, of New Jersey, and Messrs. Shepard and Co., commission merchants, had received the spurious thread in question. Against this firm Messrs. Coates filed a bill to restrain them from vending the thread. Messrs. Shepard and Co., at the time of the bill being filed, had nearly sold out the second invoice sent to them, and offered to stay proceedings by delivering up the thread left on hand and paying the costs at the date of their answer. This offer was refused, and the cause coming to a hearing, the plantiffs were allowed a perpetual injunction with costs of suit. The defendants denied all knowledge of the fraud; but the fact that the thread, although marked "Coates's best six-cord thread," was, in fact, only a three-cord thread, together with other circumstances, had completely overset this line of defence.

*Freshening Salt Water.*—Dr. Polli, of Milan, known to the medical world by his remarkable researches on the blood, has just communicated to the Scientific Congress at Naples, a proceeding to render salt water drinkable by means of electricity.—*Medical Times.*

*The Skew Arch an Old Invention.*—Now visit the Alcazar (Cathedral at Seville;) but observe a singular Moorish skew arch, in a narrow street leading (from the Cathedral) to the Puerta Xerez. It proves that the Moors practised this now assumed modern invention at least eight centuries ago.—*Ford's Spain.*

*Purifying of Gas.*—M. Peclet lately laid before the Society of Encouragement of Paris, a machine for the purifying of hydrogen gas, used for lighting. It is composed of a horizontal cylinder, partly filled with lime water, the axis or axle-tree of which is covered with diaphragms of metallic canvass, turned slowly; the gas is introduced into this cylinder, and is stated to be much better purified than in the common apparatus in use.

*Manufacture of Iron.*—Thirty-one pounds of Shropshire iron has been made into wire upwards of one hundred and eleven miles in length: and so fine was the fabric, that a part of it was humorously converted, in lieu of the usual horsehair, into a barrister's wig! The process followed to effect this extraordinary tenulty, consists of heating the iron and passing it through rollers of 8 inches diameter going at the rate of four hundred revolutions per minute, down to No. 4 on the wire gauge. It is afterwards drawn cold, at Birmingham or elsewhere, down to the extent of 38 on the same gauge, and so completed to the surprising length of one hundred and eleven miles.

*The Rattler* screw-propelled steam-sloop, Commander Smith, is having an altered screw fitted. The screw having proved a great drawback to her speed when under sail, a hatchway is being cut from the upper deck down into the dead-wood, by which means the screw may be lifted up so as not to impede her progress when under canvass, and may be altogether removed or replaced, if damaged, without going into dock.

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☞ INTENDING PATENTEES *may be supplied* gratis *with Instructions, by application (post-paid) to Messrs. Robertson and Co.* 166, *Fleet-street, by whom is kept the only* COMPLETE REGISTRY OF PATENTS.

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Edited by J. C. Robertson, No. 166, Fleet-street.


## HARVEY'S PATENT SAWING MACHINERY.

Fig. 1.

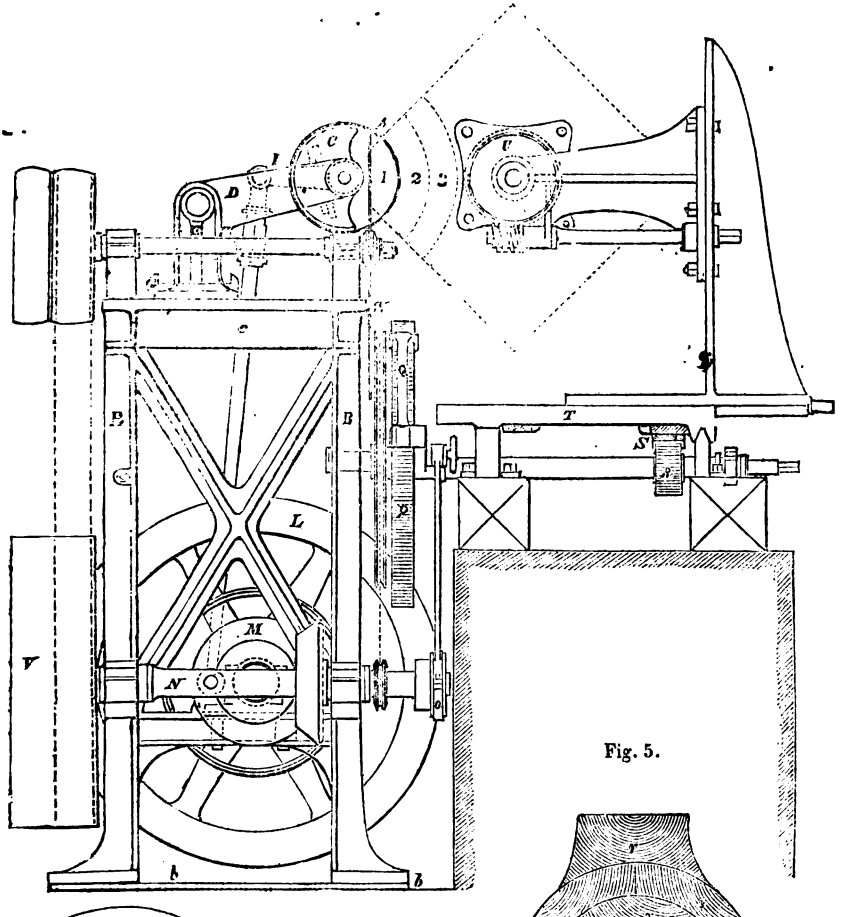
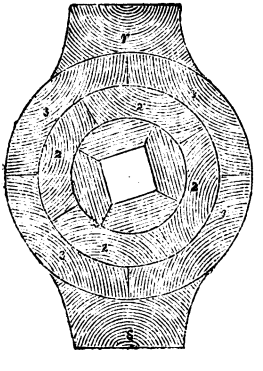



Fig. 5.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## HARVEY'S PATENT SAWING MACHINERY.

[Patent dated June 7; Specification enrolled December 7, 1845.]

SAWING by machinery is no novelty, but the sawing, whether effected by straight or by circular saws, has hitherto been chiefly in straight lines. To saw wood, as the machinery which forms the subject of the present patent does, into curvilineal forms *of any longitudinal dimensions*, from a chair back to a ship's mast, is a thing which we believe has never been accomplished by machinery before.

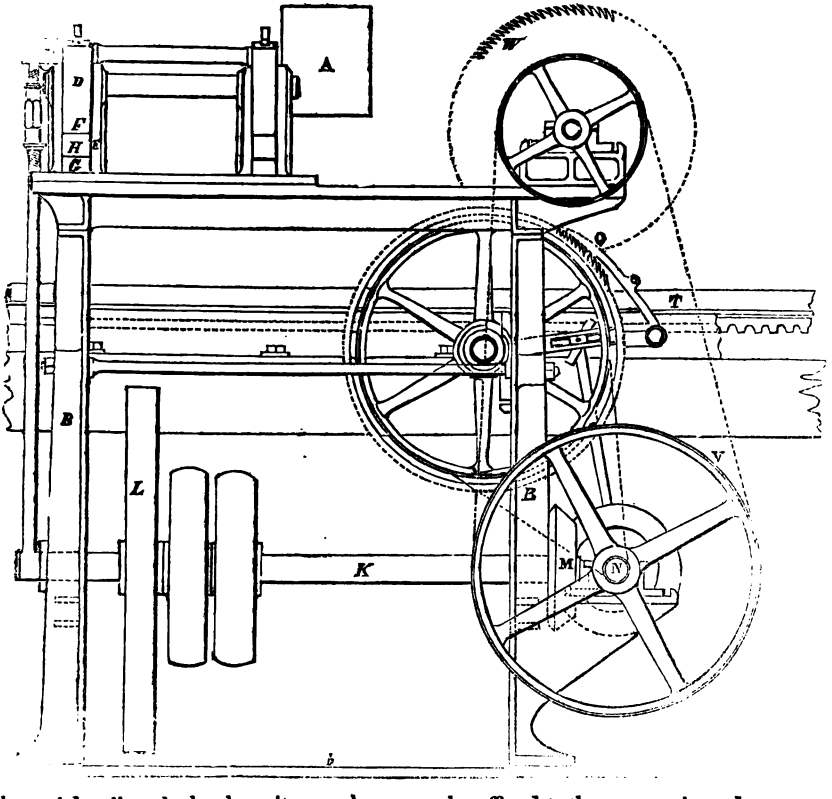
The principal instrument of this important improvement is a cylindrical saw of a very ingenious construction, an end elevation of which is given in figure 1. It is there represented as being applied to the cutting of a square log of wood into curved pieces (1, 2, 3,) suitable for subsequent conversion into ship's masts or spars. Fig. 2 is a side elevation of the general system of machinery of which this saw is a part.

The saw, A, consists of a blade or ribbon of steel, set round the circumference of a chuck, C, which has two-fifths, or thereabouts, of its periphery removed, in order that each portion of wood as it is cut off may pass through the space left between the cutting portion of the saw and the body of the chuck itself; B, the frame of the machine, is composed of two chucks, or end pieces, connected by a bed-plate, *b*, and an upper plate, *c*, and stiffened by wrought-iron stays and ties. The saw, A, is carried by arms, D D, which turn on a joint in the upper carriage, E, so that they may be set in any required position above, or below the axis of that joint, by means of the quadrant F, in which position they are retained by means of the keys, G, which raise the curved piece, H, into contact with the quadrants. An oscillating movement is given to the saw by the lever, I, which derives its motion through the medium of a connecting-rod from the crank on the end of the main-shaft, K. This shaft, K, is driven by the fast and loose pulleys thereon, being assisted in its motion by the fly-wheel, L. Upon the other end of the shaft, K, is keyed a mitre wheel, M, which takes into another upon the cross shaft, N, which has an eccentric, O, on the end thereof, next the work, for the purpose of moving the ratchet-wheel, P, by the pall, Q. The shaft carrying the ratchet-wheel, has also upon it a pinion, R, which takes into the rack, S, attached to the sliding carriage, T, and gives thereby the feed to the log. The carriage slides along the *v* guides, which are bolted to the timber frame. The log under the operation of the saw is supported at each end by chucks capable of revolving in adjusting centres, one of which, shown at U, is furnished with a worm-wheel and screw to admit of the log being turned on its axis, and set at any part of its revolution. A driving pulley, V, on the outer end of the shaft, N, gives motion to the circular saw, W, by a pair of fast and loose pulleys on its axis. The office of this saw, W, is to remove the edges, or angles of the log prior to its being cut by the cylindrical saw, A, and for this purpose, the log is fed forward by the gut pulleys, J J, and the rack and pinion, R, S, before mentioned. To accommodate the length of the connecting-rod to the different positions of the axis of the cylindrical saw A, the rod itself is varied correspondingly in length, by a screwed coupling thereon.

Figure 3 represents the curved pieces, 1, 2, 3, after being detached from one corner of the log. Fig. 4, the centre piece, which remains after each of the other corners has been treated in the same way, and which centre piece is then cut into two as indicated by the dotted lines, *m*, *n*. Fig. 5 represents the whole of the pieces into which the log has been thus cut, combined into the form of a mast, or spar. The pieces, 1 1, are first brought all together; then the pieces, 2 2, outside of 1; and next the pieces, 3 3, outside of 2, so that the three sets form a series of concentric circles with but a small hollow space, *o*, left in the centre; every joint in each series being broken or crossed by a solid piece coming opposite to it. The two pieces, *r*, *s*, cut from the heart of the log, serve as fishes to the mast or spar, one on each side. The whole of the square log is thus converted without any waste of stuff into a circular mast, or spar, which will, it is stated, be found of greater strength than any circular mast or spar of one piece.

The patentee next describes "a set of sawing machinery constructed on the same principle as the preceding, adapted to the cutting of chair backs, and other

Fig. 2.




like articles;" and also how it may be modified so as to cut ogees and curves of a similar character, *whether convex or concave.*

Neither is the ability of the machinery limited to the employment of one saw only at a time; for two, three, or more may be affixed to the same axis, and two, three or more cuts made at one and the same time. The saws, too, may be all fixed either in the same plane, or the one in advance of the other, and they may also be of any breadth required.

## MISCELLANEA MATHEMATICÆ.

Under this title we intend to give, fr time to time, as opportunity offers, a ies of notes upon curious or impor- ta topics connected with pure and ap- pl l mathematics. In certain cases th may be comments on papers which ha appeared in our own pages; in ot s, extracts from scarce or little- kn n works; and frequently original sp ulations on different points of the sc ce, which may admit of a more brief fo than would be required for a sepa- ra ticle in the Magazine. We invite the co-operation of our correspondents; and shall give to each article the name of its contributor, — reserving, however, the claim to so modify any communication as to suit our own views.

### *No.* 1.—*The Circle.*

The proportionality of the area of two circles to the squares described on their diameters, was a truth very early known in the school of Plato; and it has been proved, with all the rigour for which that school is so remarkable, by Euclid in

the twelfth book of his elements. The only idea, however, of comparing figures of one genesis with figures of another, that is indicated in the fragments that are left us of the ancient geometrical writers, is in those of Archimedes; and as Archimedes was, to a certain extent, a heretic as regards the orthodoxy of the Platonic dogmas in geometrical philosophy, we may infer that all ideas of quadrature (and rectification, which is still, in respect to the views of that school, more remote from a pure logic,) must have remained "without form and void"—except by the "infusion of new blood" into the philosophy of the Greeks.

The "heretic" gave the accurate quadrature of the parabola, and a rough approximation to that of the circle; and the Syracusian philosopher has more claim to the parentage of the most improved processes of modern times, than scientific historians are disposed to state distinctly, however strong may be their convictions on the subject. The man who first gives a distinct, a definite, and a *working* idea, in science, does more for that science than the most industrious and applicatory thinker amongst his successors. His is a subtle elaboration of a principle in the mind;—theirs, only the abandonment of intellect to the concatenations and necessary consequences of the elaborated principle. Such a one was Archimedes, in comparison with Cavallerius, Leibnitz, and Newton!

We are quite aware of the nature of the opposition which will be urged to our views on this head—of the charge of incompleteness in the argument of Archimedes, and the inconclusiveness of the reasonings of Cavallerius and Wallis—of the unsatisfactory discussion of the series of an expansion by Leibnitz—of the ungeometrical notion of a fluxion as enunciated by Newton. All we have to say in reply is, that when an argument, which is *bona fide* a new one is offered to us, we shall take it into consideration with the utmost degree of respect; but till we are supplied with such a one, we shall claim the indulgence of believing that no theory of infinitesimals, fluxions, or differentials, is essentially different in its principles from the theory which led Archimedes to the quadrature of the parabola, and the approximate rectification of the circle. We admit, at the same time, the immense simplification in its application of that principle, and the immense extension of that application beyond the limits to which it is at all possible that Archimedes conceived to be within the range of human intellect. We do not, indeed, say that the Syracusian would for one moment have felt a doubt of the applications of his principle, had they been propounded to him, but simply that, as they embraced a larger range of conception than could have passed through his mind, he would have been incapable of suggesting them himself. This condition is inevitably incident to every science, and in every stage of that science, whoever may be the investigator, and whatever may be the principle under consideration.

We do not know of any one before the "great Scaliger," who gave the perimeter of the inscribed hexagon in the length of the circumscribing circle! Scaliger was a fine specimen of the first classical scholar of his time, turned geometer! However, it was to Archimedes that the first approximation is due, who gave the diameter of the circle to its circumference, as 7 : 22. Ages rolled on before Metius extended it to the ratio 113 : 355. When, however, the subject became one of interest to the geometers, since the revival of letters in Europe, successive approximations have been made by successive investigators, till it would seem impossible for ingenious trifling to be carried further! To do more,—to have even done so much,—has been in the estimation of rational geometers, only an absurd waste of the precious moments allotted to us by the Creator for higher purposes. There do, indeed, seem to be born, men who are created for triviality of existence—and to such men, perhaps, this task of drudgery is well fitted! It is, however, analogous to many tasks which men impose upon themselves, not only in mathematics, but in the sciences, and in the arts; and if these trivialities keep such men "out of social mischief" they do their amount of good: but that men of intellect, capable of better things, and men who aspire to the character of mathematicians, should so mistake the purposes and aims of mathematical science, does appear to us to be "passing strange."

In all constructive problems, three or four places of decimals to the diameter unity are sufficient; and for computation, the utmost number ever used is six

or seven—and even to this extent, in cases of extreme rarity. In a future magazine we shall give constructions of different degrees of approximation; in this we confine ourselves to mere numbers.

It would be too tedious to give all the little details by which the approximation of Metius led to that of Van Ceulen, which it is generally said that he ordered to be engraved on his tomb. He obtained by the method of continual bisection, *thirty six* places of figures: Abraham Sharp extended it to *seventy two*: Machin to *one hundred*; and Delagny to *one hundred and twenty-eight*. There is alleged to exist on the authority of Baron Zach, (for we know of no other person who professes to have seen it,) a MS. in the Bodleian Library, Oxford, which carries the approximation to *one hundred and fifty-two* places: but Mr. Rutherford, of the Royal Military Academy, has carried the approximation to *two hundred and eight places!* Can numerical drivelling go further? We should indeed wonder to see it! As a mere curiosity we annex the Rutherford numbers; and as these include all the others, the extent of each approximation may be marked by our readers themselves: and we trust, that before any one troubles us again relative to the perimeter of the circle, he will well consider the extensions already made, and the forms of the series by which they have been computed.

To diameter 1, the circumference is—

3·14159 26535 89793 23846 26433 83279 50288 41971
69399 37510 58209 74944 59230 78164 06286 20899
86280 34825 34211 70679 82148 08651 32823 06647
09384 46095 50582 23172 53594 08128 48473 78139
20386 33830 21574 73996 00825 93125 91294 01832
80651 744

*Phil. Trans.* 1841.

On the *absolute* quadrature of the circle many ingenious persons have ignorantly wasted much time. We have ourselves received sufficient materials for a large volume, in the way of attempts to "square the circle"; and in several cases requesting us to put the authors "in the way of obtaining the government-reward for solving this problem"—estimated by themselves at 20,000*l.*, at least! We have even been offered the bonus of one shilling per cent as a liberal reward for our part of conducting the money from the Exchequer to the pocket of the inventor! Nor does the notion appear to be peculiar to England: for the French Academy was so deluged with communications on this and two other imaginary desiderata, that almost a century ago it was obliged to announce publicly, (and very publicly too,) that it would receive no more communications on the quadrature of the circle, the trisection of angle, or the duplication of the cube. these cases, like that of perpetual mo- by mere mechanism, the inventors men of knowledge so limited, that any mpt to convince them of their error arguments intelligible to themselves ruitless; and they blunder on to the of their lives, alternately appealing osterity and pouring their maledic- upon the prejudices of "mere atific men." It may, however, be as well to remark, that the incommensurability of the circumference with the diameter has been most completely established by Lambert in the Berlin *Mémoirès*, 1761; Legendre has proved that the arc is incommensurable with the tangent of that arc, and therefore with every trigonometrical function of it; and finally, Professor Young has proved that all powers of the circumference are incommensurate with the same powers of the diameter.—Legend. Geom., note iv., and Young's Math. Diss. p. 115.

It cannot be denied, that the research after the quadrature of the circle has brought to light many important properties of the figure itself. For instance, the fine assemblage of properties in the work of Gregory St. Vincent originated in this attempt; and the philosopher of Malmesbury essayed his powers on the same subject—though, unfortunately for his self-esteem, Dr. Wallis was his cotemporary. This, however, is only analogous to the modern chemistry in connexion with the search after the philosopher's stone, or the *elixir vit.*

It may be worth while, in conclusion, to state that Montucla paid much attention to the methods proposed for "squaring," or for "rectifying" the circle; and in his dissertation on this subject he displayed his usual industry and power of analysis. A neat edition of Montucla's

work, as far as regards this subject, was published in Paris a few years ago, under the superintendence of Lacroix.

### THE OBLIQUE ARCH—AND ANTIQUITY OF THE ORDINARY ARCH.

Sir,—Amongst your "Notes and Notices" in the last Number of your Magazine, you have given an extract from Mr. Ford's recent work on Spain; where it is stated, that an oblique arch, built by the Moors eight hundred years ago, still exists in the Alcazar. Of course, in giving the statement of the author, you are not pledged for its accuracy; nor can you be supposed to give your own opinion as to its being, in the modern sense of the word, a *true* "skew arch." The arch being oblique to the street is no proof of its obliquity to the faces of its buttresses, and those buttresses having their bases parallel to the line of the street: which are the true characteristics of the modern skew-arch. In fact, the street is more likely to be oblique to the faces of the buttresses than those faces are likely to be oblique to the arch. At least, till this is satisfactorily cleared up, by the inspection of a competent judge of the essential characters of the skew-arch, we should receive this statement with due caution.

A mistake was made by Belzoni of much the same character, when he imagined that he had found the ordinary arch in some of the ruins of Thebes; and a similar mistake has been made more than once respecting some remains of the earlier of the Grecian buildings, of the "Cyclopean" age. There were, indeed, cylindrical apertures in the walls, and cylindrical passages in the buildings: but these were not formed by means of *voussoirs*, which is the true characteristic of the arch, but of excavations made (or left) in the horizontal courses of the buildings.

From the days of Mandeville to those of Swift, it was the universal opinion, that a "traveller" and a "fictionist" were synonymous terms; and this opinion was justified, with scarcely a single exception, if a single one, which was literally such. The *coup de grace* was given to this style of travel and narrative by the travels of Lemuel Gulliver, as it had before been given to the wildness of knight-errantry by Cervantes. Travellers now confine their narratives to what they see—or *think they see*. The man, however, who is most happy in his perception of national character, or most discriminative in matters of mere taste, is not always the one most completely qualified for discriminating works of art or discussing questions of science. At all events, till we have some better authority than that of a mere traveller, of whose *scientific* character we know nothing, and upon whose judgment respecting such a question we have no proof afforded us, I feel (and probably you will feel much like me) disposed to withhold my assent to the statement of the Alcazar arch being, in an engineering sense, a true oblique arch.

The claims even for Italy being the birth-place of the oblique arch, are not, to my own mind, altogether satisfactory; but upon this I may hereafter offer a few remarks. In any case, it is open to more than doubt whether the knowledge of this structure existed amongst any people whatever in the year, A.D. 1000.

I am, Sir, your obedient servant,

CENTURION.

Horne, January 5, 1846.

### ON THE SUPPOSED INFLUENCE OF THE MOON UPON THE WEATHER. BY WALTER CRUMP, ESQ., F.R.S.

There is no more common belief, even among those who make accurate observations on other subjects, than that changes of the weather are more decided, and occur more frequently at changes of the moon than at any other period of the month. A similar influence is very generally ascribed to the full moon; and not a few look for changes at the commencement of every quarter.

I had abundant opportunity of observing the firmness with which this opinion is held by a class of men who are placed in circumstances that may be thought the most favourable for testing its correctness. In December, 1820, I sailed in a Maltese vessel from Valletta to Marseilles, and took six weeks to perform what is usually done in ten days. I soon became desirous to gather opinions of the weather, and found them to be formed entirely on the phases of the moon. Every new quarter was to bring a favourable wind, and although we were repeatedly disappointed, the next quarter was still anxiously looked forward to for relief. During that voyage, my faith in the moon, if I ever had any, was thoroughly shaken, and I afterwards became desirous to procure facts which would enable me to form an accurate opinion on the subject. I was not a little pleased, therefore, to meet, in the following year, with a paper by Professor Olbers, of Bremen, "On the Influence of

the Moon upon the Seasons;" confirming most satisfactorily the views I had formed upon slighter examination.

As on all subjects where uncertainty prevails, and where men are guided more by imagination than by fact, there is here the greatest variety of opinion. In some of our almanacks minute directions have long been given for predicting the weather for the succeeding half month, from the hour of the day or night at which the moon enters the first or the third quarter; and I know that they obtain very general credit, their antiquity forming an important argument in their favour. For instance, if we have new or full moon at midday, we may expect much rain in summer, and rain and snow in winter. If at midnight, the weather will be fair in summer, and fair and frosty in winter; and so on, for every two hours in the twenty-four. These predictions, or rather rules for predicting, we are assured, have stood the test of half a century; but if, as is said, they were drawn up by Dr. Samuel Clarke, from his own experience, they must have existed at least a hundred and twenty years.

I trust that the great prevalence of such impressions will excuse me with the Society for calling their attention to it; and if, to some of its members, the statements I have collected are already familiar, they may be reminded that it is through a Society like ours that error on such subjects may be expected to be removed from the public mind. There are, certainly, more dangerous errors, but it cannot be doubted that the habit of holding loose notions upon matters even of little importance, incapacitates for accurate thinking on those which are of greater consequence.

It may be desirable, in the first place, to take a glance at the early history of this belief. I have, therefore, selected a few of the more important of the facts brought together by the learning and industry of Bishop Horsley, and read by him to the Royal Society in 1774.

Arstus, an astronomer and physician, who lived in the time of Euclid, appears to have been the first to collect, in his book of Prognostics, the notions of this kind that were prevalent in his day. That work, owing more, it is said, to the quality of the verse in which it is written, than to the interest taken in its statements, procured commentators in abundance among the Greeks and Romans. Pliny relates at great length the celestial signs; Germanicus translated them, and Virgil recommends them to the serious consideration of agriculturists. Aratus prognosticates the weather from a great variety of objects—from the heavenly bodies —from animals, plants, and terrestrial objects, but, from the moon's aspect in particular, he could predict the weather only from one quarter to another. These predictions were founded upon the indications which the moon gives of the existing state of the earth's atmosphere. Thus, he says, if the moon, on the 4th day, cast a shadow the weather will be fine during the remainder of the first quarter—meaning, that the moon at that early stage, is a delicate test of the clearness of the atmosphere. Again the bluntness of the horns in the new moon is a sign of approaching rain, for if the air were clear, they would be of their natural pointed shape. And after the half moon the horns being then always blunted, other indications are given for predicting the weather till the full moon.

But the vulgar, says Dr. Horsley, soon began to consider those things as causes which had been proposed to them only as signs. The manifest effect of the moon on the ocean, while the mechanical cause of it was unknown, was interpreted as an argument for her influence over all terrestrial things; and these notions were so consistent with the visionary philosophy of the times, that such men as Theophrastus and Varro, who should have been its opponents, ranged themselves on the side of the popular prejudice. Theophrastus says that the new moon is generally a time of bad weather; the light of the moon being wanting, and that changes of the weather generally fall on the new and full moon, and on the quadratures. Pliny had his eight critical days for changes of the weather, which were the days of new and full moon, the quadratures, and the four octagonals, or rather the nearest odd numbers to these days, viz. the 3rd, 7th, 11th, and so on; for besides the influence of these periods, there was much of virtue in the odd numbers. And so great a man as Varro, as he is quoted by Pliny, was not ashamed to give this childish rule for predicting the weather for a month to come, from the appearance of the new moon. "If the upper part of it," he says, "be obscure the decline of the moon will bring rain; if the lower horn, the rain will happen before the full; and if the blackness be in the middle, we shall have rain at the time of the full moon." Theophrastus and Aratus taught their followers to remark the position of the horns at different times of the moon's age, whether they were erect, inclined or prone, and thence to take conjectures of approaching fair weather or tempest.

"On the whole," says Dr. Horsley, "I do not deny that the observant husbandman will find useful prognostics in the appearances of the moon, and the heavenly bodies in general, but they will be prognostics of

no other kind than the sputtering of the oil in the industrious maiden's lamp, and the excrescences which gather round the wick. They will show the present state of the air however, and may thereby furnish conjectures for two or three days to come."

The subject has of late years occupied the attention of some of the most distinguished astronomers of Europe, and numerous observations have been made to ascertain the amount of influence exercised by the moon over our atmosphere. Every different position has been carefully investigated, and years of observation have yielded results adverse to the popular impression. A few of these I shall relate, not in the order of their publication, but by taking up each question separately.

1st. *Does a change of weather occur at changes of the moon, or on the days on which the moon enters a new quarter, more frequently than on other days of the month?*

Dr. Horsley registered, during two years, every considerable change of weather that took place, and arranged the results in tables, showing at the same time the day and hour at which the moon entered each of her quarters. During the first of these years sixty-nine decided changes were recorded, and twenty-two of them occurred on days corresponding to the quarters, or octants, which is just four more than their even proportion. But rejecting the changes which were reversed within the twenty-four hours, there remain, out of forty-six changes in all, only ten on the days of lunar influence, which are two less than belong to them on the even chance, for the days of syzygy, quadrature and octant=98, and 365 : 98=46 : 12½. Of these ten changes only two coincided with a new moon; two also with a full moon, but they were reversed within twenty-four hours.

During the succeeding year, 1774, Dr. Horsley continued his register, omitting however September and November, these two months having been particularly changeable. Here thirty-nine changes occurred in ten months, of which fourteen were on the days specified, being four more than their equal share. Of these fourteen, only four fell on the day of a new moon, and none at all on the day of the full. If we take the latitude of three days before and three days after every quarter, which the popular idea allows, and thus increase the number of the influential days, more changes of the weather would of course occur on such days, but still only the proportion due to that increase of number.

I might here adduce the opposite results of Toaldo of Padua, obtained by computation from a course of fifty years' observations by the Marquis Poleni, and showing that many more changes occurred at the new and full moon, than at the first and last quarter; but they seem to be of no value, for it turns out that, *assuming* the moon's influence to be greatest at the change and the full, Toaldo spread these periods over three days, including the day before and the day after, and then compared the changes of weather that occurred on all the three days with those of the single days on which the quarters fell. Toaldo uses an extraordinary argument to enforce his conclusions. "Every one," he says, "is aware from his own experience, that the nails and hair grow much more quickly when cut during the increase of the moon than when cut during the wane."

In opposition to Toaldo, there are twenty-five years of observations of the different phases of the moon, by Pilgram of Vienna, which give as their result:—

58 Changes of weather on the days of New moon.
63 — on those of the Full moon.
63 — at the Quarters.

The difference is no doubt occasioned by the difficulty of deciding what constitutes a change of weather in the sense understood by Pilgram. Were it otherwise, these results would prove seven or eight per cent. fewer changes of the weather at the change of the moon than at any other period of the lunation—a conclusion at which no one has ever arrived, and which is altogether improbable.

Olbers, the celebrated discoverer of Pallas and Vesta, declares that the experience of many years has convinced him that at least in the climate of Bremen the rules of Toaldo are utterly false. "We shall be convinced," he adds, "of the smallness of the moon's influence, if we reflect that weather of the most opposite kind occurs in different parts of the world at the same moment, and consequently with the same lunar phase. This is most readily observed during an eclipse, when accounts of the weather arrive from many different quarters. The remarks for example, that were made during the solar eclipse of the 18th November, 1816, have been collected in this way, and furnish a singular mixture of good and bad weather spread on that day over a great part of Europe." Olbers quotes also the observations of Professor Brandes as furnishing results to the same effect.

2nd. *Does the moon influence rain?*

This question has been investigated by Schubler in a course of twenty-eight years'

observations in different parts of Germany. His results were published in 1830, and they seem to show that rather more rain falls during the waxing moon than when it is waning; and also that a greater number of rainy days occur during the first half of the moon's course than during the last. But I do not trouble the Society with Schubler's tables. Being a mean result of mixed observations, they do not bear upon the question in hand; for, whatever change of weather took place at one change of the moon might be balanced by an opposite change at the next—the popular belief acknowledging equally a change from fair to foul and from foul to fair—I will only mention that he found five per cent. more rain to fall during the seven days when the moon was nearest to the earth, than when at the most distant part of its orbit. Schubler's results, as I have said, decide nothing as to changes of the moon producing changes of the weather; but they seem to show that some relation does exist between the moon and our atmosphere. They are affected, however, by too many foreign influences; and are summed up from observations too little capable of precision to entitle the deductions from them to rank among ascertained facts.

3rd. *Does the moon influence the winds?*

The meteorological tables published in our monthly scientific journals, give the direction of the wind at a particular hour of each day. Such tables, indeed, differ materially when made up a few miles from each other; and they mark the slightest local breeze equally with the most generally prevailing wind. No very important conclusion can therefore be drawn from them; and yet we may expect, from the balancing of the various other causes of change, that if the phases of the moon influence at all the movements of the atmosphere, these movements will be perceptible in summing up the results of a series of years. If it cannot be perceived from such results that the winds change more decidedly at new moons than on the other days of the month, neither can it be noticed by an observer, whose only register is his memory; and it may reasonably be presumed, that changes in the other phenomena constituting weather, which are generally accompanied, if not regulated, by changes of the wind, are also incapable of being traced to lunar periods.

I have chosen, as most convenient for reduction, the register of the winds kept at Chiswick, near London, and published in the Philosophical Magazine. The state of the wind at one o'clock of each day is that which is noted. In order that the amount of change from one day to another may be stated in numbers, I have marked as 1 a change equal to one-eighth of the circle; as, from N. to N.E., or from S.W. to S. A change of two-eighths is marked 2; and the greatest change, viz. from N. to S., or from S.E. to N.W. marked 4—thus,

| | | | | |
|---|---|---|---|---|
| 1838, Feb. | 8, | S.W. | | |
| | 9, | S.W. | 0 | Full Moon. |
| | 10, | N.E. | 4 | |
| | 11, | N. | 1 | |
| | 12, | N. | 0 | |

An abstract is given of tables drawn up in this manner from observations of six years.—(*For which see next page.*)

Thus in 1838, on the 12 days of the new moon, the amount of change, as compared with the previous 12 days, was equal to 12. On the second day of the moon it was 14. On the 12 days on which the first quarter fell, the changes were equal to 16. It here appears that the average changes for one day of the moon's age in each of the 73 moons is 82, and that 85 changes occurred during the 73 days of new moon, or 3 more than the average. But it also appears that on the days of full moon and of the first quarter, the changes are still more; and that all of them are exceeded by several of the intermediate days on which no lunar influence is supposed to be exerted. It will further be remarked, that on the days of the new moon, the changes vary from 8 in 1842 to 0 in 1841, and that in three of the years they are below the average of 13½. To account for the omission of certain days in the table, it is necessary to explain that as each quadrature had to be placed in the same line, and, the number of days between the quadratures being unequal, blank days frequently occurred in the columns which had been marked the 5th and 6th, 13th and 14th, 21st and 22nd, 29th and 30th days of the moon, and that these have been omitted for the purpose of shortening and simplifying the table.

4th. *Have tides been observed in the atmosphere?*

They must be assumed to exist by all who acknowledge the moon's influence upon the atmosphere, for scarcely in any other way can such influence be supposed to be exerted. An atmospheric tide, however, like that of the ocean, must twice every day have its ebb and flow—changes quite as great as those

to which the effects in question are attributed; and yet we never hear of changes of weather being expected in correspondence with each of these atmospheric waves. But even the existence of any double diurnal oscillation produced in the atmosphere by the attraction of the sun and moon, has never yet been detected. It is altogether insensible to an ordinary barometer. Laplace reduced a great number of exact observations, and found the differences due to those attractions so minute and so variable as to leave him in doubt of their sensible existence; and Arago, to whom we are indebted for much information on this subject, after a minute detail of the observations of Flaugergues and Bouvard, arrives at essentially the same conclusion.

We have no ground, therefore, either from theory, or direct observation, for believing that the moon produces any change upon the weather; or, at least, it must be allowed (to use the words of Dr. Olbers,) that its influence is so slight as to be lost among the infinite number of other causes and forces which destroy the equilibrium of our easily disturbed atmosphere, and therefore altogether insensible to ordinary observation.—*Pro. Phil. Soc. of Glasgow.*

*Table showing the Changes of Wind in connection with Moon's age.*

| | 1838 12 Moons. | 1839 12 Moons. | 1840 13 Moons. | 1841 12 Moons. | 1842 12 Moons. | 1843 12 Moons. | Total in 73 Moons. | Sums of five days connected with each quarter. |
|---|---|---|---|---|---|---|---|---|
| 1● | 12 | 12 | 19 | 20 | 8 | 14 | 85 | |
| 2 | 14 | 11 | 13 | 13 | 11 | 10 | 72 | 396 |
| 3 | 12 | 15 | 19 | 17 | 14 | 14 | 91 | |
| 4 | 11 | 8 | 14 | 16 | 8 | 14 | 71 | |
| 7 | 16 | 13 | 15 | 16 | 13 | 11 | 84 | |
| 8 | 16 | 16 | 21 | 13 | 11 | 7 | 84 | |
| 9☽ | 16 | 15 | 16 | 16 | 14 | 10 | 87 | 442 |
| 10 | 16 | 14 | 12 | 23 | 19 | 12 | 96 | |
| 11 | 13 | 12 | 20 | 12 | 16 | 18 | 91 | |
| 12 | 11 | 6 | 13 | 12 | 9 | 14 | 65 | |
| 15 | 21 | 14 | 21 | 23 | 12 | 16 | 107 | |
| 16 | 13 | 15 | 20 | 16 | 14 | 17 | 95 | |
| 17○ | 8 | 15 | 16 | 14 | 20 | 21 | 94 | 447 |
| 18 | 13 | 11 | 13 | 10 | 10 | 14 | 71 | |
| 19 | 8 | 10 | 13 | 23 | 12 | 14 | 80 | |
| 20 | 11 | 19 | 16 | 18 | 11 | 24 | 99 | |
| 23 | 16 | 13 | 9 | 15 | 14 | 6 | 73 | |
| 24 | 6 | 18 | 16 | 18 | 8 | 18 | 84 | |
| 25☾ | 9 | 18 | 8 | 14 | 13 | 14 | 76 | 379 |
| 26 | 7 | 16 | 13 | 12 | 13 | 7 | 68 | |
| 27 | 13 | 9 | 15 | 12 | 11 | 18 | 78 | |
| 28 | 10 | 10 | 13 | 14 | 10 | 17 | 74 | |
| 31 | 11 | 7 | 18 | 11 | 8 | 9 | 64 | |
| 32 | 10 | 13 | 22 | 12 | 14 | 13 | 84 | |
| | | | | | | | 1973 | |
| | | | Average..... | | | | 82 | |
| | | | Ditto of each year..... | | | | 13½ | |

ON ELECTRO-MAGNETIC ENGINES, THE AXIAL GALVANOMETER, ETC. BY PROFESSOR PAGE, M.D., ETC., OF WASHINGTON, U. S.

[Abstract by the Editor of the *Electrical Magazine* for January, 1846, of a paper in *Silliman's Journal.*]

Professor Page made his first attempt to obtain what he terms *an axial engine*, in 1838; but failed of success through want of suitable batteries: he has now overcome this difficulty by using Grove's battery, which at that time was not in existence. The axial engine is based upon the power of a coil conveying a current over an iron core. A suitable coil, connected with six pair of Grove's in good action, drew up within its centre a bar of iron or steel, weighing two or three pounds, and sustained it with its upper end projecting above the helix; and when the bar was very light as much of it projected above as below the helix. A bar thus circumstanced will not drop when the battery circuit is made and broken with great rapidity, but will

exhibit a vibratory or dancing motion; if, under these circumstances a string be attached to the bar, the sensation to the person holding the string is like that felt by the angler when he has a bite.

The application of the above principle to the production of an electric-motive machine may be explained in a few words:—Two or more helices are secured upon a base-board with their axes in one and the same right line. Two soft iron cores are connected in a right line by a brass rod, and in such positions that when one has reached its position of equilibrium within the one coil, the other is being acted upon by the other coil; the motion is directed by a sliding frame, and is conveyed to a crank, which moves a fly wheel; the axis of the wheel forms an electrotome for inverting the current in the respective coils, and so continuing the oscillatory movement. It is obvious that the bars might be fixed and the helices be made to move, without departing from the principle: but, practically, this is not desirable. The bars may be hollow or solid, solid being best; and soft iron being better than steel. After steel bars have been used for a while, they become of course permanently magnetic; and if the battery be now detached, and the machine be worked mechanically, it is converted into a magneto-electric machine, and will give the usual sparks and shocks.

"The peculiar advantages," says the author, "of this arrangement, are as follows; *First*, a continuous action may be maintained through a very great distance, as will be by-and-by explained. *Second*, the retardation common to all other forms of electro-magnetic engines cannot occur here; for, as the bars to be magnetized are small, they are very rapidly charged; and whatever magnetism they may retain after the galvanic current is intercepted in the helices, cannot retard their motion, as there can be no attraction between the copper wire of the helices and the enclosed iron bar. Hence, with a given quantity of battery surface, the maximum of speed and power is obtained. The retardation from the permanent retention of magnetism, the time occupied in charging a magnet to saturation, and the time required to discharge the magnet, are serious obstacles in the way of obtaining an available power in ordinary electro-magnetic machines, and occasion that singular anomaly—that the active power of such machines diminishes as their rate of revolution increases. Add to these difficulties, the influence of secondary currents, which, as I have shown several years since,* magnetize a bar of iron after the battery current is cut off, and the *third* advantage of the new engine will be appreciated; for, in the first place, the secondary current occurs in all other forms of electro-magnetic machines when the armatures or magnets are very near the point of greatest action: but, in this engine, the secondary current occurs at the farthest possible distance from this point; and, in the second place, the secondary current has no perceptible influence upon the enclosed bar when it *does* occur."

"In addition to the power of the helix in drawing the bar within itself, I have availed myself," says the author, "of an extra source of attraction, viz., the actual power of the magnet, which receives an additional impulse by the attraction between it and an armature or bar of soft iron. This impulse, which is powerful, is received at an unfavourable moment, as it is nearly at the end of the stroke; when the crank is only a short distance from the dead point; but I have made use of it nevertheless to advantage, by an arrangement, which I will describe in the next number."

*The double axial reciprocating engine* is constructed with a U-form bar, and a double set of coils. "A bar of iron of this form, having its legs 10 in. in length, was mounted upon a sliding frame; part of its weight counterpoised, and its legs inserted into two helices of 3 in. in length; the helices were then connected with the battery, and the bar was drawn through the helices, until it rested upon its bend. Thus, with a single pair of helices, and a single bar of iron, a continuous impulse was given through the space of 10 in., affording at once the elements of the most simple and efficient exhibition of magnetic powers as a propelling agent."

Professor Page has constructed an engine of this sort with a 6-inch stroke, which is the most powerful engine of the kind that he has seen; and its operation is so encouraging that he is preparing another with a 12-inch stroke: he has also availed himself of the direct power of the magnet upon a bar of soft iron, and thus gains ten per cent. in power.

*The axial galvanometer* is closely akin to these machines. In reference to other galvanometers, the author says, very truly, "there is one liability to errors from a source not sufficiently regarded, viz., the frequent disturbance of the power of the needle, by the magnetizing power of the current in the coil, which, if the needle is in such a position, as would naturally result from the action of the coil, will slowly increase its magnetic power, and if forced by

* Silliman's Journal, 1838, vol. xxxiv., p. 372.

accident or otherwise into a reverse position will diminish its power, and ultimately reverse its polarity, provided the current be powerful, and the action continue for any length of time."

In the *axial galvanometer*, a U bar of soft iron is suspended from the short arm of a beam balance, so that its two ends or poles can enter within two helices placed beneath it, so that when a current passes through the helices, the bar is drawn down, and the force or actual weight is indicated by the balance; so that the instrument might almost be termed an *absolute* galvanometer. The helices are placed upon a shelf, which can be raised or lowered at pleasure, in order to alter the sensitiveness of the instrument; when the legs are just within the helix the action is slight, but when the box is well inserted, the maximum of effect is obtained. This instrument is not intended as a sensible galvanometer, but is calculated to measure the force of large batteries. "It affords at once a valuable instrument for determining the properties of helices of various sizes and lengths, of magnets, and of all those relations and proportions between battery surface, size of iron for magnets, and number of convulsions and size of wire, which must be determined before the economy of magnetic power can be settled."

*The watchman in his box*, is an illustration in *physique amusante* of these principles. A helix is mounted upon a stand, in a vertical position, and the connections are so made, that, when the current passes the core starts up and exhibits the figure of a man, which disappears when the circuit is broken.

*The galvanic or magnetic gun* consists of four or more helices arranged consecutively. A bar moves freely through these helices; and, by means of a wire attached to the end near the breach, connection with the several helices is made and broken in succession; the iron acquires such velocity by the action of the four helices as to be projected to a distance of forty or fifty feet.

We must not omit to mention that, as the axial machines promise to be of practical value, Professor Page was desirous of securing them by patent, while he gave to the public the galvanometer, &c. But, as the following extract will show, he is peculiarly circumstanced:—"Situated as I am, being one of the examiners of the Patent Office, it becomes necessary for me to take an unusual step to secure my title to this novel invention. By the statute law, no officer in the Patent Office can take out a patent for any invention, nor acquire any interest in a patent after his appointment to office. Consequently, if one so situated should make an important invention, he can have no security as long as his invention is known to a second person. As publicity without abandonment is the strongest possible testimony in favour of an invention, I have resorted, with your indulgence, to the pages of this Journal, to establish the date and nature of my invention, and to give due caution to all as to its use in any way to engender liability. Although I cannot, without resigning my office, enjoy the usual right of invention, yet I have every reason to believe that Congress will, by special act, authorize me to receive and hold a patent for this and some other kindred inventions."

## STEAM VACUUM—CARSON'S PATENT.

Sir,—Permit me through the medium of your valuable Magazine to advert to some articles which have lately appeared in it, relative to my patent for withdrawing air. In the first place the arguments of Mr. R.S. Newall are very partial, and what is more, are fallacious. If the apparatus specified by me was old, and void of novelty, at the date of my patent in 1840, it could not be new, or novel, at the date of Messrs. Nasmyth and May's patent in 1845. Mr. Newall claims validity for the patent of the latter gentlemen on the fanciful assumption that I did not contemplate the application of my apparatus to atmospheric railways, whereas in 1839, I visited the atmospheric model line at Wormwood Scrubs, for the purpose of particularly examining the pumps, and other machinery employed with a view to effecting improvements. I do not rest the validity of my patent on the mere application to either mines or railways, *but on the fact of its being a new and useful apparatus for withdrawing air, the place of which is to be occupied by air again.* The application of steam in obtaining a vacuum according to Savery or Watt's engines does not in the least affect the validity of my claim; neither does the application of steam as proposed for distillation, or evaporation of vegetable extracts weaken my position; because all those applications were very different, and for different purposes, as I could easily show, but I am unwilling to occupy so much space in your columns. It is quite clear from the letters of your various correspondents that the apparatus I have patented is considered a highly useful one. It is also equally clear that it is identical with that wished to be claimed by some of them; but for any of the scientific and talented gentlemen who have been your correspondents in this matter, to set up a claim to the apparatus on the supposition that I did not con-

template its application to atmospheric railways is a perfect delusion.

The title of my patent, the preamble, and claim, perfectly agree with what I have here stated.

I am, Sir, your most obedient Servant,

SAMUEL CARSON.

Westow Hill, Norwood, January 6th, 1846.

### FORMATION OF DEW.

Sir,—Having lately considered the subject of "dew," and finding that no theory with which I was acquainted would explain the various phenomena thereof in a satisfactory manner, I reasoned out a doctrine of my own, which I humbly send you, hoping that you will be so kind as to give some portion of your attention to this little communication. My theory is this:—

*In order that a body may contract dew, it must first become colder than the surrounding air.*

*The body, being reduced below the temperature of the air, condenses the atmospheric moisture, which is precipitated upon the surface of the body, giving rise to the phenomenon of dew.*

It is well known that bodies lose heat by radiation, and gain heat by conduction. Therefore,

*Whatever circumstance, or quality, assists the radiation of heat from a body, or prevents the conduction of heat to it, assists the formation of dew upon that body, and conversely.*

It is found by direct experiment, that the body bedewed is colder than the surrounding air; and we know that cold condenses moisture.

We will now see how this theory explains the known phenomena of dew.

1. The under sides of suspended bodies are sometimes bedewed as well as the upper. Since the atmosphere is on all sides of the suspended body, the dew must come in all directions, but chiefly from that part where there is most air, and in that direction which gravity opposes least.

2. Clouds prevent the formation of dew. Because they prevent the radiation of heat from the earth.

3. If a dry towel, with a piece of polished metal in the centre, be placed in the open air on a dewy night, in the morning the towel will be found saturated, while the metal is hardly, or not at all, damp. The towel radiates heat, but does not conduct it; it, therefore, soon becomes colder than the surrounding air, and condenses the moisture thereof. The metal both radiates and conducts heat; it therefore retains its temperature, and receives no dew.

4. Substances of a close, firm texture, such as stones, metals, &c., do not contract dew; while those of a loose texture, such as cloth, wool, velvet, &c., are favourable. The former class radiate, but at the same time conduct heat, and therefore retain their temperatures. The latter class radiate, but do not conduct heat; their temperatures, therefore, become reduced, and they condense the atmospheric moisture.

5. The insides of shop windows are bedewed on frosty nights.

Because the cold external air chills the glass, which accordingly condenses the moisture of the warm interior atmosphere, and the glass becomes bedewed. There is no dew outside, for there the temperatures agree.

6. If cold well-water be poured into a thin glass decanter, in summer, dew will appear upon the decanter.

The cold internal water chills the glass, which accordingly condenses the atmospheric moisture.

7. Wind prevents the formation of dew.

The air is hurried over various bodies, some of which are ill-adapted to the formation of dew. Accordingly, very little of the atmospheric moisture is condensed.

That dew does not *descend* only is proved by the 1st fact.

That it does not *ascend* only is proved by common observation, for why should it appear chiefly on the top of suspended bodies, or why does it not visit the under sides of all bodies indiscriminately, instead of obeying the law mentioned in the 4th fact?

That the coldness of the air does not condense its own moisture is proved by the 1st and 3rd facts, and by the well known circumstance that the air is warmer than the bodies bedewed.

That dew exudes from a body appears highly improbable; for how can we suppose a towel apparently dry, to contain enough latent moisture to saturate itself, or how can we suppose a sheet of glass

to contain enough moisture to cover its surface with water?

Again—how can either of these four theories account for the 5th and 6th facts?

It is apparent that the thermometer is not the only instrument to be used in making experiments on dew. The *hygrometer* is essential.

Hoping you will excuse the length to which I have carried my epistle,

I am, Sir,

Yours respectfully,

J. PITTER.

7, George-street, Hastings,
January 6th, 1846.

[It will no doubt surprise our correspondent to be informed, that his theory is not new, but has been the received theory among the learned, ever since the Essay on the subject by Dr. Wells, published in 1824. To have arrived at the same results as Dr. Wells, by an independent course of inquiry, does Mr. Pitter, however, great credit; and we insert his letter, as being at once a very pleasing specimen of deductive reasoning—commendable alike for its succinctness and clearness, and well calculated to assist in diffusing a more general knowledge of the interesting truths which it contains. Some of Mr. Pitter's positions are perhaps stated in rather too absolute terms. For example, he says of dew, that "wind prevents the formation of dew." Now, though Dr. Wells found that considerable winds have this effect, he observed, at the same time, that the quantity of dew is increased "by a very gentle motion of the air." All, in short, that he ventures to affirm on this head is, that dew is "never *abundant* except in serene weather," and "never to be seen on nights *both* cloudy and windy."—ED. M. M.]

## RECENT AMERICAN PATENTS.

[From Mr. Keller's Abstracts in the *Franklin Journal.*]

FOR AN IMPROVEMENT IN CARDING MACHINES. *Hugh Whitman.*—The patentee says:—"My invention consists in dispensing entirely with the main cylinder of the common carding machine, and disposing the lickerin and the strippers and workers around the lower part of the periphery of the doffer so as to act doubly, both receiving and delivering the material to be carded directly from and to the doffer, without the aid of the main cylinder."

*Claim.*—"What I claim as my invention is the dispensing with the main cylinder of the common carding machine, by so disposing of the lickerin and workers and strippers around the lower part of the circumference of the doffer, and giving them such motion as to deliver to and receive from the doffer itself, without the aid of the main cylinder."

FOR AN IMPROVEMENT IN THE WAGON LOCK. *Daniel D. Gibson and Walker Cobb.*—The body of this carriage slides on the frame, and the brake is jointed to this frame with a lever extending up to the body, so that in going down hill the sliding of the body on the frame forces the brakes against the back wheels; and for the purpose of relieving the brake when the carriage reaches a level, the brake is connected by a chain with the swingle trees, so that the pull of the horses removes it from the wheels.

*Claim.*—"What we claim as our invention is the mode of operating the brake by means of the body sliding on the frame and connected with the levers of the brake, in combination with the mode of removing the brake from the wheels, by connecting it with the swingle tree, substantially as herein described."

FOR IMPROVEMENTS IN THE MACHINE FOR CRIMPING BOOTS. *Cosman White.*—The first section of the following claim needs no explanation, and in the second section, the object of the channel plates in the jaws referred to is to receive, in grooves made therein, projections from the gripers, to steady their operation.

*Claim.*—"What I claim as my invention and desire to secure by letters patent, is the construction of the two-hinged gripers for holding the ends of the leather whilst straining it—that is to say, being made with openings in the lower end of the gripers, bevelled on the inside, or wider on the outer than on the inner face, into which are fitted loosely hinged shutters of corresponding size and shape, between which and the griper the end of the leather is griped. A projection or cob being formed on the lower end of each griper, that runs back and forth in the horizontal grooves in the plates in the head of the jaws—the upper ends of the gripers being hinged to the horizontal connecting bar containing the female screw, into which is screwed the vertical male screw, passing through the top of the sliding frame.

"I also claim constructing the jaws with the channeled plates, in the manner and for the purpose set forth."

FOR AN IMPROVEMENT IN BEE HIVES AND THE MODE OF MANAGING BEES. *Elias Jones.*—The patentee says:—"My improvement consists in a certain new and useful combination and arrangement of a horizontal series of parallel perforated tubes for conducting the warm breath of the apia-

rian to the vicinity of the joint between the boxes where the separation and division are required to take place, for the purpose of driving the bees to any part of the boxes required whenever it becomes necessary to colonize them, said tubes serving also to sustain the comb in the boxes and to admit air for ventilation, and slides for closing them in winter, said slides also strengthening the tubes, to secure the comb attached to them. Also, in the arrangement of other tubes in the sides of the boxes, to admit the breath of the apiarian for directing the bees to the position required in the boxes, for the purpose above set forth."

*Claim.*—"What I claim as my invention and desire to secure by letters patent, is the arrangement of the horizontal parallel tubes and slides, and the manner of dividing the bees by means of the breath, as set forth."

FOR AN IMPROVEMENT IN THE TOOL CALLED THE SHOEMAKER'S SHOULDER IRON FOR SETTING OR POLISHING THE EDGE OR FOREPART OF THE SOLES. *James W. Newberry.*—In the instruments or tools now used for this purpose, the bevel edge, which is used to polish the edge of the sole, is permanently connected with the shoulder which determines the thickness of the sole, and therefore one instrument is required for each thickness. This patent is granted for connecting the bevel edge with the shoulder by a slide regulated by a screw, so as to adapt one instrument to any thickness of soles. The claim is limited to the combination of the bevel edge and shoulder, in the manner described, the distance between the two being regulated by a screw or other analogous device.

FOR AN IMPROVED MODE OF PREVENTING THE EXPLOSION OF STEAM BOILERS. *Cadwallader Evans.*—The patentee says—"The nature of my invention consists in the application of the difference in the expansion of two metals or the expansion of a metal so applied as to cause a safety valve to open, to regulate the supply of water in the boilers, to give notice of the fall or scarcity of water, to regulate a damper, to extinguish the fire by letting water spout on it, and to show the relative temperature of the steam or boiler; all of w[illegible]ch can be performed by the same ma- c[illegible]e respectively, and at the time required, o[illegible]ach can be applied separately."

*Claim.*—"What I claim as my invention i[illegible]he application of the difference in the e[illegible]ansion of two metals or the expansion o[illegible] metal, as a means of preventing explo- s[illegible]s of steam boilers, in the manner des- c[illegible]ed, or any analogous means producing t[illegible]ame result or effect."

[illegible]R AN IMPROVEMENT IN THE HOT BLAST BLOOMERY FORGE FIRE. *Paul A. Sabbaton.*—On each side of the fireplace there is a large horizontal tube, one to receive the blast of air from the blower, and the other connected with the tuyers, and these two pipes are connected together for the passage of the air by means of bent tubes in the form of an inverted U, and placed immediately over the fire to have the flame impinge on them.

*Claim.*—"I do not make any claim to the applying of the hot blast thereto; nor do I make any claim to the form or combination of the pipes for heating the air, this being the same with numerous others which have been long known and used; but what I do claim as my invention and desire to secure by letters patent, is the manner in which I have combined said pipes with the bloomery forge fire, by placing them within the chimney immediately over said fire, which chimney is formed in the manner herein described and represented, so as to effect the desired object, without the use of an arch, or of any analogous structure. To this particular combination and arrangement, I limit my claim."

FOR AN IMPROVEMENT IN TEMPLES FOR POWER LOOMS. *Erastus B. Bigelow.*—In this temple the upper jaw is attached to one end, and the lever by which it is worked to the other end of a rod jointed to a long bar, which is in turn jointed to the breast beam of the loom, so that the lay shall strike the lever that opens the jaw at a considerable distance from the jaw. *Claim.*—"What I claim as my invention, and desire to secure by letters patent, is having the moveable jaw at one end, and the lever by which it is operated at the other end of the rod, and near to the joint which connects the bar to the beam, in combination with the long bar jointed to the breast beam, so as to act when there is little or no motion, by which the operation is rendered more effective and the free action unimpeded and more certain."

FOR AN IMPROVEMENT IN THE PUPPET VALVES OF STEAM ENGINES. *Samuel Talbot.*—The patentee says, "The nature of my invention consists in providing and arranging in the centre of the main steam valves a small valve to be opened sufficiently in advance of the main valve, to allow the steam to fill the vacuum between the piston and head of cylinder, and thereby produce an equilibrium of pressure upon the top and bottom of the same, before the lifting rod acts upon it, thereby allowing it to be raised by an amount of power sufficient to raise the weight of the same. *Claim.*—"What I claim as my invention, and desire to secure by letters patent, is the use of the

small valves, operating in the centre of the main valves and by the same motions, substantially as above described; by which arrangement much of the power required to open the valves in the old way, is saved for the direct action of the engine."

FOR A RELIEF SPRING FOR SHIPS' CABLES, AND OTHER PURPOSES IN WHICH IT IS REQUIRED TO OVERCOME THE MOMENTUM OF HEAVY MASSES. *Levi Bissel.*—The cable or other thing to be relieved from a sudden jar, is connected with a wedge which slides between two rollers, one of them being connected with the piston of a pneumatic spring, so that the wedge cannot slide, without overcoming the pressure applied to the surface of the wedge by the spring.

*Claim.*—"What I claim as my invention, and desire to secure by letters patent, is the combination of the inclined plane, rollers, and spring, in the manner above described, for any of the above-mentioned, or for any other purpose to which the same may be applicable."

FOR IMPROVEMENTS IN LAMPS. *Edwin B. Horn.*—The character or principle of the improvements secured by this patent is fully expressed in the following

*Claim.*—"I shall claim surrounding the wick chamber by the outer tube or casing, which intervenes between it and the reservoir, said tube or casing being constructed so much larger in its interior diameter than the external diameter of the outer tube of the wick chamber, as to form a space between the two, through which the air descends and passes into the inner tube of the burner to act upon the interior surface of the flame. Also, bending the button rod under the wick chamber, and continuing it upwards between the same and the external casing or tube, and combining said button rod, so arranged, with a crank upon the end of a small horizontal arbor, the same being for the purpose of elevating and depressing said rod and button, the whole of the above parts being constructed and arranged substantially as herein above set forth."

FOR IMPROVEMENTS IN WINDOW BLINDS. *Garner Wilkinson.*—The slats of these blinds slide on two rods permanently secured to the top and bottom of the window frame, and there ends are connected together by joint links and intermediate rods, forming chains at the sides of the blinds, to permit the slats to come close together when the blinds are drawn up by a cord that passes from the top through a hole in the middle of each slat, and attached to a hook at the bottom, by which the whole is secured to the sill of the window.

*Claim.*—"What I claim as my invention and desire to secure by letters patent, is the method above described of connecting the slats together by means of links and intermediate rods, so as to enable them to approach each other in drawing them up; and in combination with the above, I claim the method of fastening them by means of the hook attached to the lower slat, and to the cords by which they are drawn up, all as herein above described."

---

*The "Satisfactory" Janus.*—Another attempt has been made to take this vessel round to Portsmouth, and this time with success. We quote the following notice of the achievement from a Portsmouth article of Wednesday last, in the *Times*. It will be seen that the writer confirms the statement, which we made in our last, that the engines are to be taken out. "The *Janus* steam-vessel, on the design of Vice-Admiral the Earl of Dundonald, which came into harbour yesterday morning, remains off the King's-stairs. The engines are being taken to pieces by Mr. Taplin's men, and that officer will have the sole duty of endeavouring to make her engines answer, or to have some made like them, as those now in her are quite worn out, not so much with work as with alterations and borings. Mr. Fincham, master shipwright of this dockyard, having constructed the *Janus*, may also assist in "making something of her." The following account of the performances of the *Janus* in her passage here is furnished by an officer on board her and may be relied on as impartial and authentic:—"We started on the 2nd, at noon, from Chatham; anchored four miles below the Mouse; weighed at eight next morning, passed through the Downs at twelve, steaming the whole of the time, no sail on her at all, wind from the south-west; we steamed on until off Dungeness, the wind then freshening very hard; stood off and on all night, with a close-reefed topsail breeze, sea very short and high. She proved herself to be a very fine sea boat. On Sunday at 11 a.m. we bore up (weather very thick and hazy) for Dungeness, and anchored at 3 p.m.; weighed at 2 a.m., on Monday, and steamed the whole of the day until we arrived at Spithead, without the use of sail (the wind being right a-head), and anchored as the gun fired from the flag-ship at 8 o'clock. We weighed at 7·30 yesterday morning, and steamed round the anchorage at Spithead, after which we came into harbour. We averaged five knots per hour, taking the voyage throughout. In the afternoon of yesterday Professor Airey and other scientific gentlemen and officers came on board, and, wishing to make a trial, the steam was got up, and every other preparation made for starting; but on the engine being set in motion it almost immediately stopped, after having made only two revolutions, and we dropped anchor. Her engines are now being taken to pieces, in the endeavour to discover the cause of failure, and to remedy it if possible. She must have new engines, however."

☞ INTENDING PATENTEES *may be supplied* gratis *with Instructions, by application (post-paid) to Messrs. Robertson and Co.* 166, *Fleet-street, by whom is kept the only* COMPLETE REGISTRY OF PATENTS.

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Edited by J. C. Robertson, No. 166, Fleet-street.


## CLAUSSEN'S IMPROVEMENTS IN WEAVING LOOPED FABRICS.

Fig. 2.

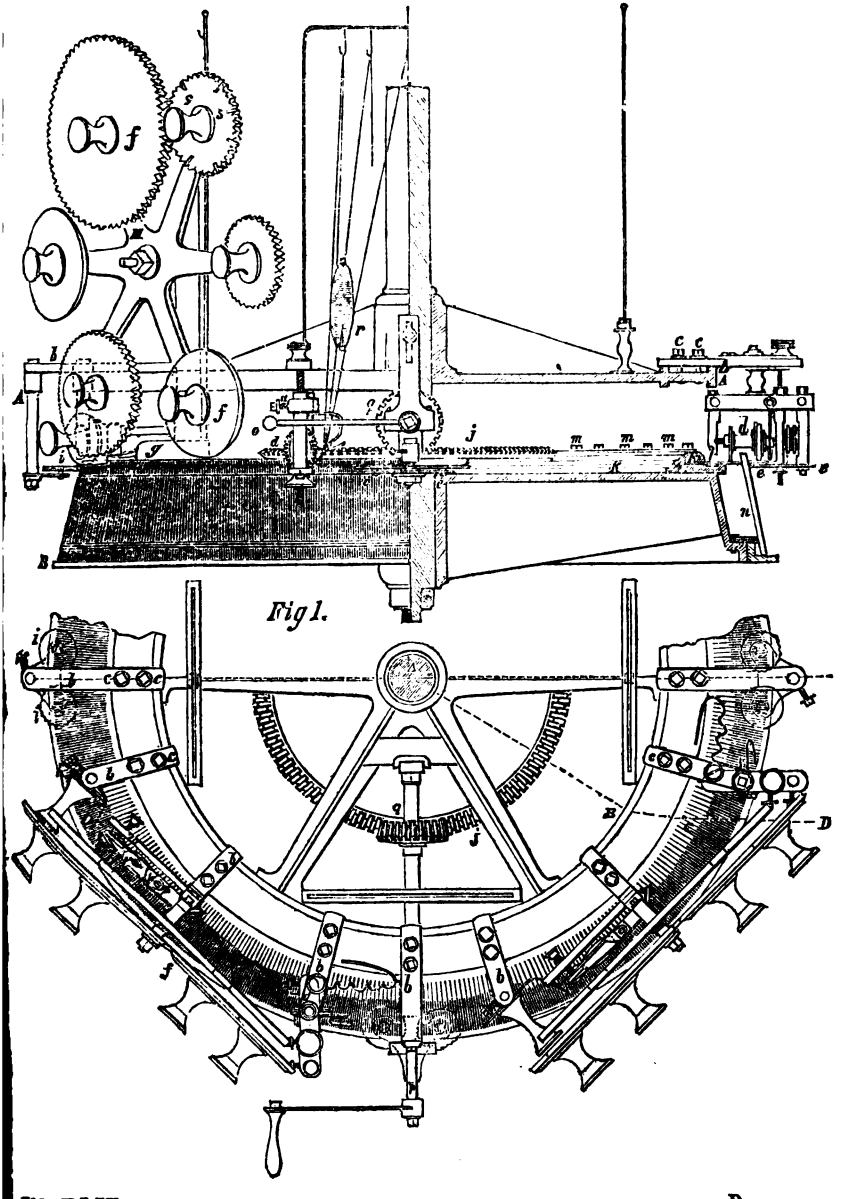


*Fig 1.*

## CLAUSSEN'S IMPROVEMENTS IN WEAVING LOOPED FABRICS.

[Patent dated June 18, 1845; Specification enrolled December 18, 1845.]

FIGURE 1 is a plan of half of a loom constructed according to the improvements which form the subject of this patent; and figure 2, an elevation of the same, with a part in section taken on the line A B C D, of figure 1. The loom consists of two parts, an upper, A A, and an under, B B, mounted on one common vertical shaft, the former of which is fixed or stationary, and the latter moveable. The part $A^1$ $A^1$ is made fast to the shaft X, by means of the screw *a*, and consists of a broad circular ring of cast-iron, with six radial arms, to the upper face of which ring the brass plates, *b b*, are attached by means of screws, *c c*. Each quarter of the ring carries one entire set of parts, by which the weaving is immediately effected, which parts are supported by the plates, *b b*, and consist, first, of a feed-wheel, *d*; second, a pressure-wheel, *f*; third, a sinker-bar, *g*; fourth, a sinker-wheel, *h*; and fifth, a wheel, *i*, for pressing the work.

The under part, B B, is also circular, and of cast-iron, and is provided with the same number of radial arms; it is free to revolve on the same shaft as that to which the upper part, $A^1$ $A^1$ is attached. It has fixed to it a horizontal toothed-wheel, *j*, and also a circular brass-ring, *k*, which is composed of two separate pieces, one placed on the top of the other, between which the needles, *l l*, which are made of steel, are securely held by the screw, *m*. The periphery of the under part of the loom is of a conical form, and it is surrounded with a comb-plate, composed of a series of small plates, *n n*, being similar to that employed in the common weaving loom.

The loom is put in motion by turning the crank-handle, O, fixed on the outer end of the axis, *p*, which carries a pinion, *q*, which works into the teeth of the horizontal-wheel, *j*, which takes round with it the under part, BB, to which it is fixed.

The working parts of the apparatus being thus set in motion, the feed-wheel, *d*, takes the thread as it unwinds from the bobbins, *r r*, and transfers it to the needles. The oblique position of this wheel, of which a detailed description will be hereafter given, has for its object to enable it, in the first instance, to lay the threads on the body of the needles, and to make them afterwards pass under the barbs. A disc, $e^2$, presses the comb-plates, *n n*, inwards, towards the peripheries of the under part, B B, to prevent them from interfering with the action of the feed-wheel, *d*, and also to prevent the needles from yielding when they are required to take up the threads. When the needles have received the thread from the feed-wheel, *d*, they come under the pressure-wheel, *f*, which presses down the barbs, and thus allows the loop formed in the preceding round, (where there has been such a preceding round,) to escape from the needles. Notches or spaces, $a^1$, may be cut out of the circumference of the pressure wheel, as shown at $f^2$; in which case a double loop will be formed, because of the wheel not pressing on those needles which come immediately under such spaces. The number and position of these spaces may be calculated, so as to produce different and regular patterns in the web. And there may be an assortment of such wheels adapted to various patterns, kept ready mounted on a radial frame, M, so that one may be substituted for another, as required.

The sinker-bar, *g*, serves to push the comb plates towards the periphery of the loom, and consequently to draw the thread from the needles after having been placed there by the feed wheel, *d*. This bar is composed of two parts, connected by a screw, *y*; one of these parts is stationary, and the other, *t*, is moveable around the screw, *y*, so as to allow of the bar being drawn back towards the exterior of the loom, according as more or less depression is required to be given.

The drawing back is effected by acting on the presser-bar, *g*, by the screw W, in the bar Y. The sinker-wheel, *k*, serves to press down such loops as may not have been freed from the needles by the sinker-bar, while the spring, *o*, in front of that wheel causes the plates, *n n*, to move back into their places out of the way. The wheel, *i*, pushes back the comb plates, *n*, as well as the work, against the exterior face of the periphery, so as to allow the feed-wheel, *d*, to pass clear in the following course.

Fig. 4.

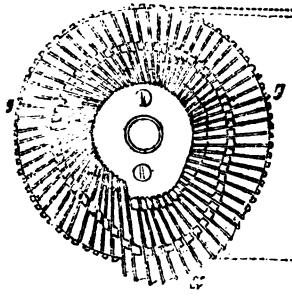



Fig. 3ª.

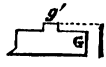



Fig. 3.

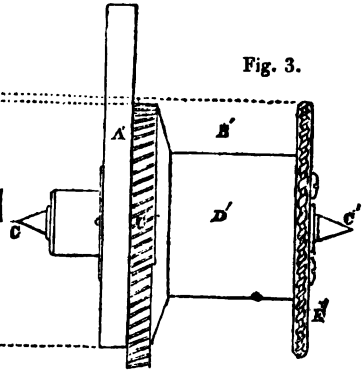



Fig. 6.

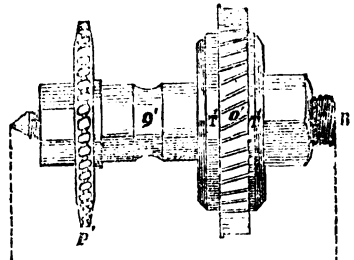



Fig. 5.

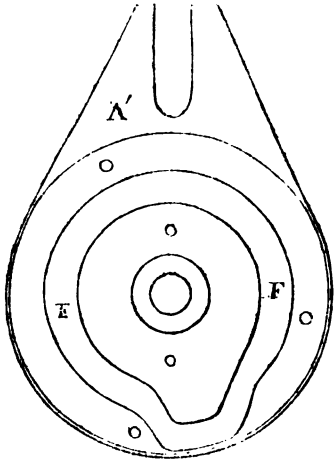



Fig. 7.

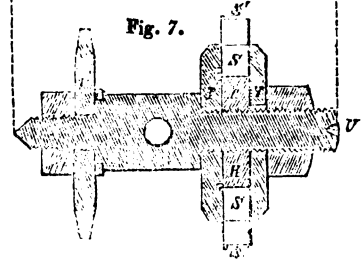



Fig. 9.

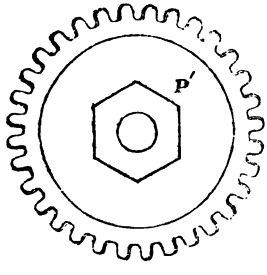
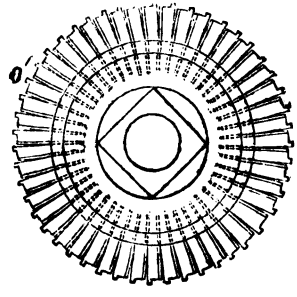



Fig. 8.



The feed-wheel, *d*, may be made either with moveable or with fixed teeth. Fig. 3, is an elevation of it as fitted in its place in the loom. Figs. 3, 4, and 5, represent it with moveable teeth. The wheel consists of two parts, $A^1$ and $B^1$; the one part, $A^1$, is fixed, while the other part, $B^1$, is free to move round an axis, C. The part $B^1$ includes the feed wheel, $G^1$, properly so considered, and a guide-wheel, $E^1$, the two being united by an intermediate cylinder. The fixed part, $A^1$, consists of a brass plate, into which a steel plate is inlaid, having an eccentric groove, FF, cut in it, as shown in Fig. 5. The moveable part, $B^1$, is furnished with teeth composed of small steel blades or strips, G, furnished with projecting studs, $g^1$ $g^1$, (see Fig. 3*a*, which exhibits a detached view of one of these blades.) These teeth are placed obliquely in slots, or sockets, made for their reception, as shown in figs. 3 and 4. When the parts, $A^1$ and $G^1$, are united face to face, the ends, $G^1$, take into the eccentric groove, F, and on the wheel rotating, the teeth necessarily follow in the direction of the groove, whereby they are made to protrude sufficiently to lay hold of the thread, and pass it under the barbs of the needles; while, as soon as the thread has been so taken hold of, the action of the eccentric causes them to recede into the interior of the wheel.

A feed-wheel with fixed teeth is represented in figs. 6, 7, 8, and 9. Fig. 6 is an elevation of this wheel, and fig. 7, a section on the line AB, of fig. 6. It consists of a toothed wheel, $O^1$, (shown separately in fig. 8,) and of a guide-wheel, $P^1$, (fig. 9,) both mounted on one shaft, $Q^1$. The wheel, $O^1$, consists of a brass disc, $R^1$, in which are fitted the steel teeth, S, furnished with projecting studs $s^1$. This disc, $R^1$, is enclosed between two iron plates, TT, one on each side, and all three are tightly bound together by means of a nut and screw, U. The guide-wheel is secured to the opposite end of the shaft. The moveable tooth wheel is superior to the wheel with fixed teeth, inasmuch as but few of the teeth are protruded at a time, and by means of the eccentric, much finer, as well as much coarser, yarns can be used, than with the ordinary wheel. But, on the other hand, the fixed tooth wheel, which offers this considerable advantage, that the teeth can be replaced or repaired, in case of accident, with great facility, by simply turning the nut U, and removing the iron plate $T^1$.

## THE WIRE SUSPENSION AQUEDUCT OVER THE ALLEGHANY RIVER, AT PITTSBURGH.

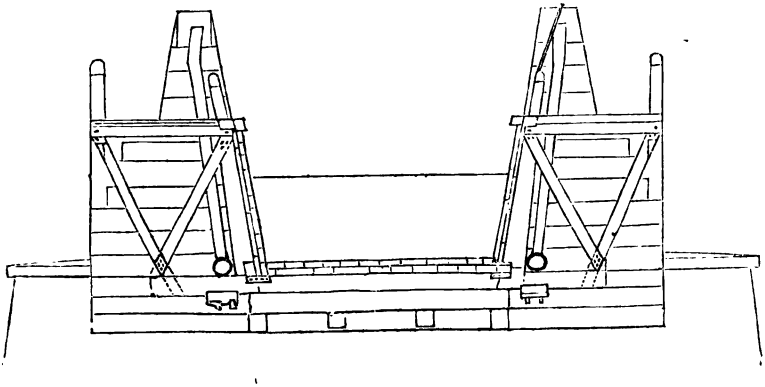
This work, recently constructed under the superintendence of John A. Roebling, the designer and contractor, has supplied the place of the old wooden structure which originally was built by the State of Pennsylvania at the western termination of the Pennsylvania Canal.

The Council of the city of Pittsburgh by whom, in consequence of an arrangement with the State, the tolls on this aqueduct are of late received, and who are bound to keep the work in repair, decided on re-building, and after considering various plans, adopted that of Mr. Roebling, and entered into contract with him to re-construct the communication, for the gross sum of 62,000 dollars, including the removal of the old ponderous structure and the repair of the pier and abutments; a very small sum indeed for a work of such magnitude. As this work is the first of the kind ever attempted, its construction speaks well for the enterprise of the city of Pittsburgh.

The removal of the old work was commenced in September, 1844, and boats were passed through the new aqueduct n May, 1845.

This work consists of 7 spans, of 160 feet each, from centre to centre of pier. The trunk is of wood, and 1140 feet long, 14 feet wide at bottom, 16½ feet on top, the sides 8½ feet deep. These, as well as the bottom, are composed of a *double* course of 2½ inch white pine plank, laid diagonally, the two courses crossing each other at right angles, so as to form a solid lattice-work of great strength and stiffness, sufficient to bear its own weight and to resist the effects of the most violent storms. The bottom of the trunk rests upon transverse beams arranged in pairs, four feet apart; between these, the posts which support the sides of the trunk are let in with dove-tailed tenons, secured by bolts. The outside posts, which support the sidewalk and tow-path, incline outwards, and are connected

with the beams in a similar manner. Each trunk-post is held by two braces. $2\frac{1}{2} \times 10$ inch, and connected with the outside posts by a double joist of $2\frac{1}{2} \times 10$. The trunk-posts are 7 inches square on top, and $7 \times 14$ at the heel; the transverse beams are 27 feet long and $16 \times 6$ inches; the space between two adjoining is 4 inches. It will be observed, that all parts of the framing are double with the exception of the posts, so as to admit the suspension rods. Each pair of beams is supported on each side of the trunk by a double suspension rod of $1\frac{1}{8}$th inch round iron, bent in the shape of a stirrup, and mounted on a small cast-iron saddle, which rests on the cable. These saddles are connected, on the top of the cables, by links, which diminish in size from the pier towards the centre. The sides of the trunk set solid against the bodies of masonry, which are erected on each pier and abutment as bases for the pyramids which support the cables. These pyramids, which are constructed of three blocks of a durable, coarse, hard-grained sandstone, rise 5 feet above the level of the side-walk and tow-path, and measure $3 \times 5$ feet on top, and $4 \times 6\frac{1}{2}$ feet at base. The side-walk and tow-path being 7 feet wide, leave 3 feet space for the passage of the pyramids. The ample width of the tow and foot-path is therefore contracted on every pier, but this arrangement proves no inconvenience, and was necessary for the suspension of the cables next to the trunk.



The caps which cover the saddles and cables on the pyramids, rise 3 feet above the inside or trunk railing, and would obstruct the free passage of the tow-line; but this is obviated by an iron rod which passes over the top of the cap, and forms a gradual slope down to the railing on each side of the pyramid.

The wire cables, which are the main support of the structure, are suspended next to the trunk, one on each side; each of these two cables is exactly 7 inches in diameter, perfectly solid and compact, and constructed in one piece from shore to shore, 1175 feet long; it is composed of 1900 wires of $\frac{1}{8}$th inch thickness, which are laid parallel to each other. Great care has been taken to insure an equal tension of the wires. Oxidation is guarded against by a varnish applied to each wire separately, their preservation, however, is insured for certain by a close, compact, and continuous wrapping, made of annealed wire and laid on by machinery in the most perfect manner. A continuous wrapping is an important improvement, which, in this case, has been for the first time successfully applied.

A well-constructed and well-wrapped cable presents the appearance of a solid cylinder, which in strength greatly surpasses a chain, made of bars of the same aggregate section or weight. It is not only the great relative strength of wire which renders it superior to bar iron, but its greater elasticity, which enables it to support strong and repeated vibrations, and add still more to its value as a material for bridge building.

The extremities of the cables do not extend *below* ground, but connect with anchor chains, which, in a curved line, pass through large masses of masonry

the last links occupying a vertical position. The bars composing these chains average 1½ × 4 inch, and are from 4 to 12 feet long; they are manufactured of boiler scrap and forged in one piece without a weld. The extreme links are anchored to heavy cast-iron plates of 6 feet square, which are held down by the foundations, upon which the weight of 700 perches of masonry rests. The stability of this part of the structure is fully insured, as the resistance of the anchorage is twice as great as the greatest strain to which the chains can ever be subjected.

The plan of anchorage adopted on the aqueduct varies materially from those methods usually applied to suspension bridges, where an open channel is formed under ground for the passage of the chains. On the aqueduct, the chains below ground are imbedded and completely surrounded by cement. In the construction of the masonry, this material and common lime mortar have been abundantly applied. The bars are painted with red lead. Their preservation is rendered certain by the known quality of calcareous cements to prevent oxidation. If moisture should find its way to the chains, it will be saturated with lime, and add another calcareous coating to the iron. This portion of the work has been executed with scrupulous care, so as to render it unnecessary on the part of those who exercise a surveillance over the structure to examine it. The repainting of the cables every two or three years, will insure their duration for a long period.

Where the cables rest on the saddles, their size is increased at two points by introducing short wires and thus forming swells, which fit into corresponding recesses of the casting. Between these swells, the cable is forcibly pressed down by three sets of strong iron wedges, driven through openings which are cast in the side of the saddle.

When the merits of the suspension bar were discussed previous to the commencement of the structure, doubts were raised as to the stability of the pyramids and the masonry below, when unequal forces should happen to disturb the equilibrium of adjoining spans. It was then proved by a statistical demonstration, that any of the arches with the water in the trunk, could support an extra weight of 120 tons, without disturbance to any part of the work. In this examination, no allowance at all was made for the great resistance of the wood-work and the stiffness of the trunk itself. During the raising of the frame-work, the several arches were repeatedly subjected to very considerable unequal forces, which never disturbed the balance, and proved the correctness of previous calculations.

The stiffness and rigidity of the structure is so great, that no doubt is entertained that each of the several arches would sustain *itself* in case the wood-work of the next one adjoining should be consumed by fire. The wood-work in any of the arches separately may be removed and substituted by new material, without affecting the equilibrium of the next one.

The original idea upon which the plan has been perfected, was to form a *wooden trunk*, strong enough to support its own weight, and stiff enough for an aqueduct or bridge, and to combine this structure with wire cables of a sufficient strength to bear safely the great weight of water.

The plan of this work, therefore, is a combination which presents very superior advantages, viz., *great strength, stiffness, safety, durability, and economy.*

This system, for the first time successfully carried out on the Pittsburgh aqueduct, may hereafter be applied, with the happiest results, to railroad bridges, which have to resist the powerful weight and great vibrations, which result from the passage of heavy locomotives and trains of cars.

*Remark.*—The quantities in the following table are calculated for a depth of water of 4 feet, which has been in the aqueduct ever since the opening. The depth contemplated was 3½ feet; a greater depth is at present required on account of the raising of the bottom of the canal by bars and sediment, which have to be removed before the level can be lowered.

*Table of Quantities on Aqueduct.*

| | |
|---|---|
| Length of Aqueduct without extension | 1,140 feet. |
| Length of cables | 1,175 ,, |
| Length of cables and chains | 1,283 ,, |
| Diameter of cables | 7 inches. |

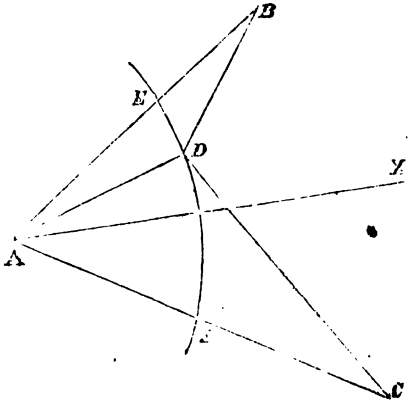
| | |
|---|---|
| Aggregate weight of both cables | 110 tons. |
| Section of 4 feet of water in trunk | 59 sup. feet. |
| Total weight of water in aqueduct | 2,100 tons. |
| ,, ,, one span | 295 ,, |
| Weight of one span, including all | 420 ,, |
| Aggregate number of wires in both cables | 3,800. |
| Aggregate solid section of both cables | 53 sup. inches. |
| ,, ,, anchor chains | 72 ,, |
| Deflection of cables | 14 feet 6 inches. |
| Elevation of pyramids above piers | 16 feet 6 ,, |
| Weight of water in 1 span *between* piers | 275 tons. |
| Tension of cables resulting from this weight | 392 ,, |
| Tension of one single wire | 206 lbs. |
| Average ultimate strength of one wire | 1,100 lbs. |
| Ultimate strength of cables | 2,090 tons. |
| Tension resulting from weight of water upon 1 solid square inch of wire cable | 14,800 lbs. |
| Tension resulting from weight of water upon 1 square inch of anchor chains | 11,000 lbs. |
| Pressure resulting from weight of water upon 1 pyramid | 1,37½ tons. |
| ,, ,, ,, ,, ,, 1 superficial foot | 18,400 lbs. |

*Franklin Journal.*

## THE CASE IN RAILWAY ENGINEERING.

The very amplified discussion of this problem, printed at page 179 of the preceding volume, might seem to render further notice of it needless. The problem itself, apart from its professional illustration, is one extremely well known amongst mathematicians; and the conditions to be fulfilled are laid down by every writer on *maxima* and *minima:* but as no construction can be effected by simpler means than the intersection of a circle and a conic section, and as the computation to which your correspondent's solution leads is very complex, it may be worth while to point out a much briefer method of investigation—one, also, which leads to a much less laborious calculation.

Such problems as these may furnish useful exercises for the young mathematician; but in a practical point of view they are altogether nugatory, being attended with an amount of labour, and its consequent and increasing uncertainty of result, which deprives them of all value. In fact, having found the condition, that the angles ADB, ADC must be equal, and D situated in a given circle, of which A is the centre, it becomes extremely easy with two, or at most three, trials, to assign that point with greater precision than by any other process, whether of construction or calculation. The following investigations have, therefore, no pretension to *practical* value, though they may not be considered destitute of a degree of *analytical* elegance.



Draw A X to bisect the angle A: put A B $=b$, A C $=c$, B D $=u$, D C $=v$, A D $=r$; and likewise, D A X $=\theta$, and B A X $=$ C A X $=\frac{1}{2}$ A $=a$.

Then we, have

$$u^2=r^2-2\,br\cos(a-\theta)+b^2 \ldots\ldots (1)$$

$$v^2=r^2-2\,cr\cos(a+\theta)+c^2 \ldots\ldots (2)$$

Also in virtue of the property of *minimum* referred to in the former solution, we have

$$\cos \text{ A D B}=\frac{r^2+u^2-b^2}{2\,ru}=\frac{r-b\cos(a-\theta)}{\sqrt{r^2-2\,br\cos(a-\theta)+b^2}} \ldots\ldots (3),$$

$$\cos \text{ A D C}=\frac{r^2+v^2-c^2}{2\,rv}=\frac{r-c\cos(a+\theta)}{\sqrt{r^2-2\,cr\cos(a+\theta)+c^2}} \ldots\ldots (4),$$

And hence,

$$\frac{r-b\cos(a-\theta)}{\sqrt{r^2-2\,br\cos(a-\theta)+b^2}}=\frac{r-c\cos(a+\theta)}{\sqrt{r^2-2\,cr\cos(a+\theta)+c^2}} \ldots\ldots (5);$$

or, squaring, and otherwise reducing, it becomes

$$\frac{r-b\cos(a-\theta)}{r-c\cos(a+\theta)}=\frac{b\sin(a-\theta)}{c\sin(a+\theta)};\text{ and finally,}$$

$$r\{(c+b)\cos a\sin\theta+(c-b)\sin a\cos\theta\}=bc\sin 2\theta \ldots\ldots (6).$$

Neat, however, as this form may be, like all others, it still becomes of the fourth degree when suitably prepared for calculation, whatever be the function of $\theta$ employed.

There will be given, of course, *four* values of $\theta$: and it would be necessary to test them after computation, to ascertain which belongs to the case proposed. One will express a *minimum*, one a *maximum*; and the two others possess no special interest, except under an aspect purely geometrical.

CENTURION.

Home, January 5, 1846.

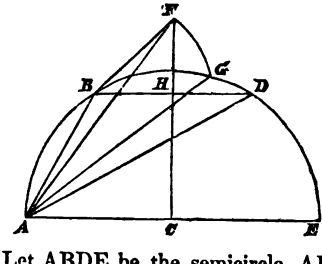
## MISCELLANEA MATHEMATICA.

*No. 2. The Circle continued, (from p. 22.)*

*First Construction; by* MASCHERONI.

We now propose to give a few practical constructions, by which a right line may be found *approximating* to the length of a given circle. They are mainly taken from the *twelfth* edition of Hutton's Course, having been originally collected from scarce foreign works by the editor of that edition.*

Fig. 1.




Let ABDE be the semicircle, AE its diameter, and C its centre. Set off AB, BD equal to the radius AC: with A and E as centres, and AD, EB as radii, describe arcs intersecting in F: and, finally, with B as centre, and BF as radius, describe an arc FG, cutting the semicircle in G, on the same side of B that D is situated. Then the chord AD is nearly

* We take the opportunity of recommending this work to such of our readers as may desire to pursue a regular course of elementary mathematical study, as being better fitted for such an object than any work of the same size and price, with which we are acquainted. In connection with the geometrical features of the work, we must remark too that the chapter on *Practical Geometry*, is altogether new in its plan, and better adapted to its purpose than any we have yet seen. The chapter on "lineation," or geometry on the ground, contains many problems of paramount use in surveying. We must especially impress upon the reader, that it is to the *twelfth edition only* that our statements apply:—this edition being a totally new work, though (we think inappropriately) taking the name of a new edition of a standard old one.—ED. M. M.

equal to the quadrant of the circle. For let H be the intersection of CF, BD: then

$$AF = AD = 2\sin 60° = \sqrt{3},$$
$$CF = \sqrt{AF^2 - AC^2} = \sqrt{2},$$
$$\text{and } FH = CF - CH = \tfrac{1}{2}\{2\sqrt{2} - \sqrt{3}\}$$

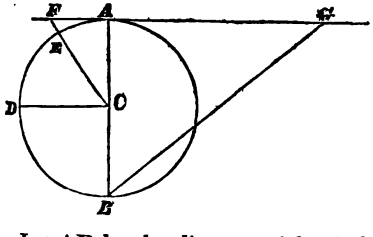
Wherefore,
$$\begin{aligned} 2AG &= 4 \sin \tfrac{1}{2} ABG. \\ &= 4 \sin (\tfrac{1}{2}AB + \tfrac{1}{2}BG) \\ &= 4(\sin \tfrac{1}{2} AB \cos \tfrac{1}{2} BG \\ &\quad + \cos. \tfrac{1}{2} AB \sin \tfrac{1}{2} AB) \\ &= \sqrt{1} + \sqrt{6} + \sqrt{9 - 3\sqrt{6}} \\ &= 3{\cdot}142399 \ldots\ldots \end{aligned}$$

But to the same decimal extent, the true circumference is 3·14159; and hence the error is less than that of a unit in the third decimal place.

This construction, which is very simple, and performable by the *compasses only*, is as close as most practical objects require.

*Second construction; by an anonymous German writer.*

Fig. 2.




Let AB be the diameter of the circle, and C its centre. Draw the tangent at A, and through C a parallel to it. Set off the line DF = DC, and draw CF to meet the tangent in E; and in the direction beyond A make EG = 3 CD. Then BG is nearly equal to the semicircle.

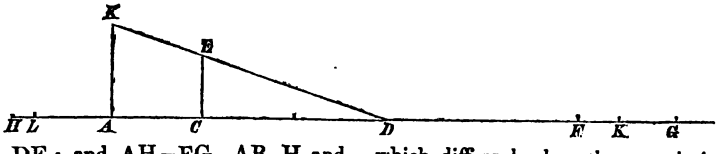
For $AE = \tan 30° = \frac{1}{3}\sqrt{3}$,
$$AG = EG - EA = 3 - \tfrac{1}{3}\sqrt{3} = \tfrac{1}{3}(9 - \sqrt{3})$$
$$BG = \sqrt{AB^2 + AG^2} = \sqrt{4 + \tfrac{1}{9}(9 - \sqrt{3})^2} = 3{\cdot}1415334 \ldots\ldots$$

This is an easy operation, and approximates more closely to the truth than the preceding one.

*Third construction; by* M. Pioche, *Statuary, Metz.*

From any point A, in the line GH, draw the perpendicular AB equal to the radius of the given circle. Make AD = 3 AB, and AC = AB; draw CE parallel to AB, meeting BD in E. Make

Fig. 3.




DF = DE; and AH = FG = AB, H and G being taken in the extensions of AF; and take $FK = \frac{1}{5}AB + \frac{1}{2}\cdot\frac{1}{5}AB = \frac{3}{8}AB$, and make $AL = \frac{4}{5}AH$. Then KL is very nearly equal to the circumference of the circle whose radius is AB.

For, KL = AL + LD + FG + FD
$$\begin{aligned} &= \frac{4}{5} + 3 + \frac{3}{8} + DE \\ &= \frac{167}{40} + \frac{2}{3} BD \\ &= \frac{167}{40} + \frac{2}{3}\sqrt{AB^2 + AD^2} \\ &= \frac{501 + 80\sqrt{10}}{120} \\ &= 3{\cdot}1415925534 \ldots \end{aligned}$$

which differs by less than a unit in the sixth place of decimals.

M. Gergonne (*Ann. des Math., tom.* viii.,) has proposed to try the same general algebraic form with other numbers: viz.

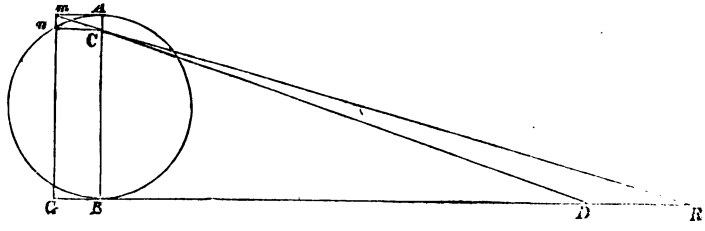
$$\omega = \frac{x + \sqrt{y}}{z}.$$

He has, however, given no result of such trials.

*Fourth construction; by* M. Quetelet, *Brussels.*

Let AB be the diameter, and $a$R a tangent at B; make $Ba = \frac{1}{4}$ AB, BD = 3AB, and $a$R = 15$a$B; from $a$ draw the perpendicular $am$ = AB, and

Fig. 4.




draw R*m* meeting AB in *c*; then joining D*c* it will be nearly equal to the circumference of the circle on the diameter AB.

For, by the similar triangles RB*c*, *cmn*, we have $mn : nc :: ma : a\mathrm{R}$; whence,

$$mn = \mathrm{AC} = \frac{nc \cdot ma}{a\mathrm{R}} = \frac{a\mathrm{B} \cdot \mathrm{BA}}{15\ a\mathrm{B}} = \frac{\mathrm{AB}}{15}.$$

Then,

$$\mathrm{B}c = \mathrm{BA} - \mathrm{A}c = \mathrm{BA} - \frac{\mathrm{BA}}{15} = \frac{14\ \mathrm{BA}}{15}.$$

Also, by the right-angled triangle D*c*B,

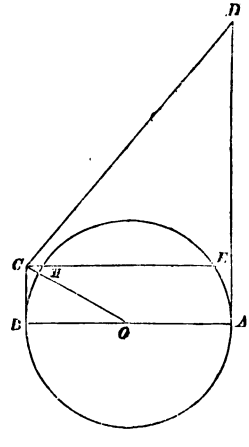
$$\mathrm{D}c = \mathrm{AB}\left\{\left(\frac{14}{15}\right)^2 + 9\right\}^{\frac{1}{2}}$$

$$= \frac{\mathrm{AB}}{15}\sqrt{2025 + 196}$$

$$= \frac{\mathrm{AB}}{15}\sqrt{2221} = 3{\cdot}1418\ldots.$$

which is less approximative than the two preceding ones, but is extremely simple in its application to practice.

Fig. 5.




*Fifth construction; by* M. Degelder, *Leyden.*

Let BA be the diameter and O the centre of the circle; make BH = 30°, and draw the tangent BC at B to meet OH in C; draw the tangent AD at A such that AD = 3OB; and finally, join CD, which will be nearly equal to the semicircle.

For, draw CE parallel to AB. Then, the right-angled triangle DCE gives

$$\mathrm{DC} = \sqrt{\mathrm{DE}^2 + \mathrm{EC}^2}$$

$$= \sqrt{(\mathrm{DA} - \mathrm{CB})^2 + \mathrm{EC}^2};$$

$$\mathrm{BC} = \tan 30° = \frac{1}{\sqrt{3}}, \text{ and } \mathrm{CE} = 2.$$

Whence,

$$\mathrm{DC} = \left\{\left(3 - \frac{1}{\sqrt{3}}\right)^2 + 4\right\}^{\frac{1}{2}}$$

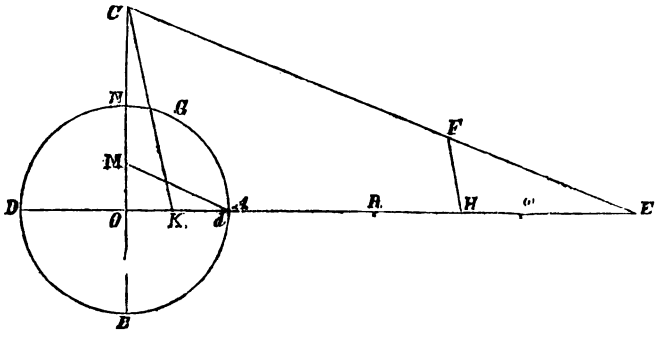
$$= 3{\cdot}14153.$$

This construction is, also, very simple and true to the fourth decimal place inclusive.

*Sixth construction; by* M. H. Godfray, *Jersey.*

Let ABDN be the circle whose centre is O; and let DA, BN be two diameters at right angles and indefinitely produced. Make OC = AD, and AE = 2 AD; join CE and make EF = AD. Again, with centre A and distance OA, describe an arc cutting the circumference in G; set off DG from E to H, and join FH; draw C*k* parallel to FH, and make K*a* = O*k*. Lastly, Draw AM parallel to EC; and

Fig. 6.




set off AR = AN, and R$\omega$ = BM. Then will $a\omega$ be very nearly equal to the semi-circumference of the circle. For,

$$
\begin{aligned}
a\omega &= O\omega - Oa = O\omega - 2OK \\
&= AO + AR + R\omega - 2(OE - EK) \\
&= 1 + AN + BM - 2(5 - EK) \\
&= 1 + \sqrt{2} + 1 + OM - 10 + 2EK \\
&= \sqrt{2} - 8 + OM + 2EK \\
&= \sqrt{2} - 8 + \frac{AO \cdot OC}{OE} + \frac{2 \cdot HE \cdot EC}{EF} \\
&= \sqrt{2} - 8 + \frac{1 \cdot 2}{5} + \frac{2 \cdot DG\sqrt{EO^2 + OC^2}}{2} \\
&= \sqrt{2} - 7\tfrac{3}{5} + \sqrt{3}\sqrt{25 + 4} \\
&= 1{\cdot}41421356237 + 9{\cdot}32737905309 - 7{\cdot}6 \\
&= 3{\cdot}14159261546.
\end{aligned}
$$

This construction is most remarkable, inasmuch as, whilst the time required to perform it is only about three-fourths of that required in Pioche's method, the approximation is true to seven decimal places. In fact, in a circle whose diameter is that of the earth, it would give an error (in defect) of only about *eighteen inches!*

We have extracted this construction from the first volume of the *Mathematician*, a periodical work under the direction of three of the Woolwich Professors. Two other constructions by Mr. Godfray are alluded to, but not given, in the same work.

## THE GAUGE QUESTION.

The railway and other newspapers have recently teemed with statements of experiments made, to ascertain which of the railway gauges—the 4 ft. 8½ or the 7 ft.—is most favourable to celerity of conveyance—or, rather, to state the case more truly, on which line of railway—the Birmingham, which is on the narrow gauge, or the Great Western, which is on the wide, the greatest speed with equal loads is attainable. We say, that the case is "more truly" put as we have done it, because it would obviously not follow of necessity, from the fact of a greater speed being accomplished on the one line than the other, that it was *to the difference of gauge* the superiority was owing. It might have been owing to other causes entirely—to better gradients, better engines, better fuel, or better management. Or, supposing it were owing to a greater width of gauge, (as it might undoubtedly,) still it might not be owing to the particular gauge adopted on the Great Western railway. The 7 ft. gauge may be as much too wide as the 4 ft. 8½ is too narrow. Both gauges, it is well known, were adopted without thought or consideration—the narrow, because it was the gauge of the old colliery tramways, on which speed was never thought of, and the latter, simply because it was something hugely different from anything adopted by anybody else, (Mr. Brunel's ordinary standard of excellence.) In either view of the case, therefore, the mere fact of a greater speed being achieved on the one line than the other would not of necessity decide, whether one gauge is better than the other. The real question to be determined is the *amount of steam which can be generated within a given time, within a given space.*

Can the number of cylinders full necessary to produce the number of strokes of the piston equal to fifty, sixty miles, or more, an hour, be produced within such boiler-room as a narrow gauge engine admits of, without injuriously, or inconveniently encreasing its length? And if not, what is the additional breadth required for the purpose? Will nothing less than twenty-seven *and a-half* inches suffice? May not the twenty-seven without *the half* do as well? Or twenty, or ten, or perhaps even five only?

We do not suppose that either the Government Commissioners, under whose superintendence the experiments we speak of have been made, or the eminent engineers who have been more actively engaged in them, need to be told that such is the complexion to which things must come at last. But certain it is, that the manner in which these experiments have been presented to the world in the newspapers, has been such as to keep the real question at issue very carefully out of sight. Every surpassing feat of velocity on the Great Western line has been paraded and trumpeted, as if it were one more incontestable proof of the superlative wisdom and ingenuity which presided at the selection of the seven-feet gauge. Just as sensible would it be to say that, because one common road is twice as broad as another, a horse will gallop on it twice as fast.

The experiments, so far as they have gone, do appear to show that some greater width than 4ft. 8½ is necessary for the high rates of velocity desirable for mail and express trains. What that width is, remains to be determined. The newest and best information, however, we have seen on the subject is not to be found in any of the party-coloured accounts of experiments of which we have been speaking, but in the impartial evidence given by General Pasley, the Inspector-General of Railways, at the inquest held on the body of one of the sufferers by the late accident on the Norfolk Railway. The General has done himself great credit by this evidence; and we feel persuaded that we shall have the thanks of our engineering readers for here presenting it to them at length.

Major-General Charles William Pasley, being sworn, was examined as follows:—

Coroner.—The jury have been informed, Sir, that the accident, the subject of this enquiry, was caused by the excessive speed of the train, and the sudden shutting off the steam: will you have the goodness to give us your opinion?

General Pasley.—My opinion is that the shutting off of the steam suddenly, cannot possibly produce an accident to an engine.

Coroner.—Would it cause it to jump?

General Pasley.—No; I do not think it would cause it to jump, providing the road was in good order.

Coroner.—Then to what do you attribute the accident?

General Pasley.—To the engine-driver proceeding at an imprudent and excessive speed on a descending gradient.

Coroner.—Did you examine the engine?

General Pasley.—I did, and I could not find any apparent injury that could have caused the accident. From what I saw of it, it appeared to be of the best workmanship, and in a perfect state of repair at the time of running off the line.

Coroner.—I am told that these large engines are not generally adapted to the narrow gauge.

General Pasley.—My opinion is, that owing to the peculiar construction of the engines, like the one that met with the accident on the Norfolk line, they are not the most suitable to the narrow gauge, as they do not admit of any great speed without danger.

Coroner.—But the engines on the Norfolk Railway. Do they incur any danger at the rate described in the time-bill?

General Pasley.—Oh, no! They are perfectly secure on the narrow gauge at a certain rate. For instance, the distance from the Harsling-road station to Thetford is eight miles, and 26 minutes is allowed to accomplish that distance.

Coroner.—Then the distance and time noted in the Norfolk Railway Company's time-bill can be travelled over without any excessive speed?

General Pasley.—Certainly; and I will give you a reason why. If by any extraordinary neglect 10 minutes should be lost between those two stations, there is 16 minutes to go the eight miles, a rate of 30 miles per hour.

Coroner.—Can you account for the broken chair, which was 22 feet from the sleeper, that was cut apparently by the engine when it got off the rail?

General Pasley.—I should say that the chair was broken by the motion of the engine. If it was defective before, the motion might contribute to its breaking entirely.

Coroner.—What description of engine was it that met with the accident?

General Pasley.—One of most extraor-

dinary length, of such a length as was never used on the narrow or any other gauge before. If you will allow me, I will mention a circumstance respecting this peculiar class of engines. Some months ago there existed doubts as to the safety of express trains to travel by, and knowing that oscillation of carriages was no proof of danger, any more than that steadiness ensures perfect safety, I determined to ride upon the engines, with a view of more easily detecting their unsteadiness—their oscillating indicating danger. I travelled lines in different parts of the country, and the only engine I found having such an oscillation was one on the South Eastern Railway, called the White Horse of Kent, manufactured by Mr. Robert Stephenson, and of the same peculiar construction as the one that went off the rails on the Norfolk line. I went on that engine at the rate of 44 or 45 miles an hour, and at that speed she rolled something like a ship at sea.

Coroner.—And what does the oscillating movement indicate?

General Pasley.—The oscillation, when the train is going at such a rate, indicates a danger of running off the rail. I told the engine drivers and other authorities that if they ran 50 miles an hour, like the express trains on the Great Western Railway, the great likelihood of the engines rolling over. I have stated that opinion to the Gauge Commissioners.

Coroner.—What is the difference between the engine you have alluded to as manufactured by Mr. Robert Stephenson and those employed on the Great Western?

General Pasley.—The narrow gauge not offering so great a diameter of boiler as the broad, Mr. Stephenson, to remove the obstacle, constructed the long-boiler engines to equal them in power, and they have failed in the purpose for which they were intended. The long-boiler engines, which Mr. Stephenson persevered in, are 4 or 5 feet longer than those of original construction, the smoke-box overhangs the fore wheels, and fire-box and dome the hind wheels, which will cause them to oscillate.

Coroner.—Do you think it safe for such an engine to travel at 30 to 35 miles an hour?

General Pasley.—I think such an engine as the one in question can go at 30 or 35 miles an hour, and I think I have gone at 45 miles an hour upon them; but when they approach 50 I think they are unsafe, and that is an opinion not hastily formed. I have mentioned it frequently to engineers and superintendents of railways, as well as to the Gauge Commissioners. Since this accident there has been one on the North of England Railway somewhat similar.

Coroner.—Did you go down to examine the cause?

General Pasley.—No, I did not. The Gauge Commissioners, Astronomer Airy, and Professor Barlow were near the spot at the time, and these gentlemen having made a strict enquiry into it, and having sent their report to the Board of Trade, which appearing satisfactory, I did not proceed with an investigation.

Coroner.—And have you formed any opinion as to what produced that mishap? I understand Mr. Bidder was on the train.

General Pasley.—He was, and the opinion I have come too respecting that accident, was the dangerous construction of the engine, which was similar to the one that run off on the Norfolk line. There have also been two accidents on the Eastern Counties line of a like character.

Coroner.—But I was given to understand that the cause of the engine running off the Eastern Counties was the improper formation of the flanges of the wheels.

General Pasley.—They had not depth enough, and were formed at right angles. I never saw any so formed before, which rendered them very unsafe. Flanges with a depth from an inch to an inch and a quarter are perfectly secure, but they require to be much rounded at the angles.

Coroner.—Are these constructions of engines adapted to the broad gauge?

General Pasley.—No. The Great Western Railway has been worked by engines of one pattern for the last five or six years. The motive for forming the long-boiler engine was to gain a larger evaporating surface, and thereby obtaining greater power of steam. That however has failed, owing to the tube at the fore part of the boiler being so far distant from the fire-box, and not being exposed to the full action of the heat. The engines on the South-Western, Manchester and Birmingham, and Grand Junction railways, of the make of Messrs. Sharp and Brothers, with boilers of moderate length, have equal, if not more, power, and are capable of going at any speed they will admit of, providing the ground is in good order.

Coroner.—Then you think these long boiler engines, if they are going at a rate exceeding 40 miles per hour, are liable to oscillate and run over the line?

General Pasley.—Yes, I do think so.

Coroner.—And what is the cause—the defect in their formation?

General Pasley.—It is the wheels huddled together, or the axles under the boiler, that gives so much overhanging dead weight at each end, which I have not found with any other engines but those of Mr. Stephenson.

Coroner.—Did you ever mention your opinion to Mr. Stephenson relative to his long-boiler engines.

General Pasley.—No, I don't think I have; I have not seen him; but I have mentioned it to several persons employed by him, as well as his pupils.

Coroner.—And to the Board of Trade?

General Pasley.—Yes, and to the Board of Trade.

Coroner.—Did you ever anticipate an engine of this description meeting with such an accident?

General Pasley.—The fact is, that I did not expect such an accident could have taken place. I did not think that such an engine could have gone at the speed it did in running off the line. It is a rule with engine-drivers to shut off the steam on a descending gradient, and in all my journeys in railway travelling I never found them neglect doing so. I have frequently informed the engine-drivers of these engines of the danger they were incurring when driving them at a rate verging upon 50 miles per hour. In the north of England, however, I remember being on one of Mr. Stephenson's long-boiler engines, and two pair of the wheels were coupled together, and in riding upon it I felt more secure than I would upon the other ones, as the coupling produces steadiness, and consequently safety.

Coroner.—Mr. Marshall, the superintendent of the locomotive department on the Norfolk railway, has told us that the engine that caused the accident was of a different make to those that run off on the Eastern Counties.

General Pasley.—And Mr. Marshall is perfectly right; they are different in some respects, and similar in others. The engines that went off the rail on the Eastern Counties were those of Stothart, Slaughter, and Co.'s manufacture. The flanges, however, have been remedied, and they are now working on the line. Those engines, although they are of a long-boiler construction, have no overhanging weights like those of Mr. Stephenson.

Coroner.—Then you attribute this accident to the speed of the engine?

General Pasley.—Yes; to the rate of descending a gradient at 40 miles per hour, being such a rate that no prudent engine-driver would travel down an incline. I never contemplated such an accident occurring. I cannot say that there has been any reduction of the staff of officers on the line. Never observed any deficiency at the stations.

Coroner.—Have you got anything further to add, Sir?

General Pasley.—Yes, I wish to explain why I consider that the sudden shutting off of the steam could not have led to the accident—the grounds upon which I differ with other opinions. When a railway train is in motion the engine always exceeds the weight of the tender, and double those of the carriages. When the steam is shut off suddenly, more especially on a descending gradient, its momentum will drag the tender and carriages for a considerable distance, and presuming that the engine should become detached from the tender, its impetus would carry it far in advance; so much so, that the train would fail in overtaking it. The engine having a greater momentum, would proceed faster than the carriages. In order to show you the effect of suddenly shutting off the steam, I was lately on an engine on the Bristol and Gloucester railway with Mr. Connell, the locomotive superintendent, the Gauge Commissioners being in the train, when I desired a great speed to be put on, and then requested the steam to be turned off suddenly. It was done so, and not the slightest effect was produced. Again, on the Great Western railway I was on an engine with Mr. Brunel—two tenders attached and a goods'-train of 2,000 tons, with a speed of 30 miles an hour. I desired Mr. Brunel, when they had to stop at a station, to shut off the steam suddenly a minute before the breaks were applied. It was done frequently, and not the least effect felt, the tender did not crowd upon the engine, and neither did the wagons crowd upon the tender. In short, shutting off the steam produces no effect, unless the breaks are applied, more especially in descending an incline of 1 in 200. At the New Cross incline, which is 1 in 100, the trains are always stopped by turning the steam off suddenly, and applying the breaks immediately, and if the cause of the accident was really the shutting off the steam, accidents would be constantly occurring at New Cross. Whenever there was a necessity for such a step, I should have no hesitation to adopt it.

Coroner.—Then, Sir, you quite disagree with Mr. Bidder's opinion as to the cause of the accident?

General Pasley.—I consider Mr. Bidder's opinion perfectly erroneous; at the same time I wish to observe that Mr. Bidder is a gentleman of much ability, but in this case I think he is much mistaken; his opinion is contrary to the first principles of mechanics.

Coroner.—Do you think it probable that the accident could have resulted from some other cause than that you have mentioned?

General Pasley.—If there had not been any excessive speed to have caused the engine to have left the rail, it would not have produced such fearful effects.

Coroner.—Can you state the dimensions of the engine?

General Pasley.—19 feet 6 inches in length

without the foot-plates which the engine driver and occasionally the stoker stand upon, which give about 2 feet more. The distance from the centre of the front and hind wheels is 10 feet 3 inches, so that the smoke-box is projecting before the fore wheels, and the fire-box and dome overhanging the hind wheels. In all engines, before Mr. Stephenson took out his patent for the construction of the long-boiler engines, the hind wheels are in the rear of the fire-box and dome, and consequently there is no overhanging dead weight at the rear of the wheels. When I first saw the engines I thought them very good in travelling at a moderate rate, but I now see no advantage in their construction or improvement. The fore part of the boiler being so far from the fire-box, the engines do not afford the power that was expected from them. The engines of Sharp, Brothers, and Co., with moderate length boiler, possess equal or greater power, and are free from danger.

The Foreman.—Then, Sir, can you attribute the accident to the engine-driver or engine?

General Pasley.—I attribute it to the engine-driver descending an inclination at an unnecessary rate, and partially to the peculiar construction of the engine. A similar accident, however, might not occur. I consider it very doubtful whether a similar accident would have happened to an engine of any other construction.

Coroner.—Do you know if there are any signal posts to denote gradients?

General Pasley.—Yes, there are. After the first accident on the Eastern Counties Railway, the Earl of Dalhousie wrote to the Board desiring that all the inclines should be marked out with posts, which had been done to guide engine-drivers; for at the accident at Littlebury, on that line, the superintendent of the locomotive department, who was on the engine, and the driver, were really descending a gradient without knowing it.

Coroner.—Mr. Bidder has told us that on gradients of 1 in 200, engines are in the habit of travelling at the greatest velocity?

General Pasley.—Then that is contrary to my general experience. I never travelled an incline but that the steam had been partially or perfectly shut off. It is a general rule to shut it off on going down an incline. I do not think that on a gradient of 1 in 200 engines are in the habit of running at the greatest possible velocity.

Coroner.—Then we perfectly understand you to say, that shutting off steam in descending a gradient would not cause an engine to stop?

General Pasley.—Certainly, if the breaks were not applied. If the decline is 20 miles in length, it will not stop until it comes to a level. It is the effect of gravity. Its momentum forces it along.

*Verdict.*—"Accidental death, caused by the imprudent conduct of the engine-driver in going at an excessive speed."

## THE "SATISFACTORY JANUS.

[*From the Times.*]

Sir,—The frequent articles inserted in your universally circulated paper relative to the *Janus*, indicate that the success or failure of the engines, boilers, and lines of construction are subjects of public interest.

Being thus confirmed in my opinion, I enclose to you the last report made on the original revolving engine erected by the late Admiralty in Portsmouth dockyard, the performance of which engine gave to the present board the confidence they have manifested in promoting the attainment of an object highly interesting to the naval service.

Those only who attempt to introduce an important novelty can estimate the effects of jealousy and prejudice. I confide, however, in your liberality to aid in their removal, and beg that you will inquire whether any reciprocating engine has ever performed duty equivalent to thirteen consecutive double voyages from England to America, (as the Portsmouth engine has done,) almost without repair? I am, Sir, your obedient Servant, DUNDONALD.

Portsmouth, Jan. 8, 1845.

### *Report of the* EARL *of* DUNDONALD'S *Rotatory Engine erected in Her Majesty's Dockyard at Portsmouth.*

On the 22nd of December, 1845, two years and nine months of constant performance of the rotatory engine expires, during all which time it has been working in the most effectual and satisfactory manner, no derangement of consequence having ever taken place.

It is presumed that these two years and nine months of constant and laborious operation (requiring no more than slight attention by the workmen) have gone far to establish that quality which, until now, had not been sufficiently developed,—namely, durability, and consequent continuity of operation.

The principal repair this engine has required was taken in hand about nine months ago. This was so trifling that six men could have accomplished it in one day, but having been much pressed with work at the time, one man only could be spared, which consequently protracted its completion for one week.

Thus after four years and nine months constant working as a prime mover, two years and nine months of which have been so successfully performed, nothing more can be wanting even by the most sceptical to

establish its merits as a powerful, economical, and durable engine, equal in point of efficiency to any reciprocating engine in Her Majesty's service.

Should additional evidence be sought to establish further claims as a rival in steam mechanism, it is to be found in the simple fact, that this first essay on the Earl of Dundonald's principle, although at first altered and mutilated to bring it to perfection, is nevertheless at the present time perfectly free from those indications of weakness and declining energy which any other engine, under similar circumstances, might probably evince, as is proved by its exhibiting a vacuum at all times equal to 28 inches of mercury.

Another fact which gives great confidence in the utility and applicability of this principle is its freedom from liability to internal derangement, and consequently the service in which it is engaged is scarcely ever inconvenienced by stoppages.

The engine has not been opened for examination since July last. R. TAPLIN,
Engineer and Machinist.

Her Majesty's Dockyard, Portsmouth, Dec. 31, 1845.

[Mr. Taplin's report would have been much more satisfactory to the engineering public, had he told us what was the amount of work done by the engine during the two years and nine months, and what its expenditure of fuel during the time? Lord Dundonald says, the duty was "equivalent to thirteen consecutive double voyages from England to America," (say 78,000 miles!!!) but on what grounds he has jumped to so extraordinary and incredible a conclusion he leaves the world to guess.—ED. M. M.]

## SMITH'S SCREW PROPELLING PATENT.

*Court of Exchequer, January 10th.*

*Before the Lord Chief Baron and a Special Jury.*

*Back (on behalf of Smith's Steam Propeller Company) v. Steinman.*

This was an action at the instance of the plaintiff, as secretary to the Company incorporated for working the well-known patent of Mr. J. P. Smith, for screw propelling, and was brought against the defendant, the proprietor of Blaxland's patent for a similar object, for having infringed the patent of the former in three several instances; 1st, in the screw fitted by Steinman to H. M. S. *Rattler*, (see *Mech. Mag.*, vol. xlii., p. 104,) by way of trial, and afterwards removed; 2nd, in a screw supplied and still attached to H. M. S. *Phœnix*, another Government steamer; and 3rd, in a screw fitted to the *Terror*, North Polar discovery ship.

The defendant put a great many pleas on the record, but the only material issues were; 1st, whether the invention of screw propelling, as claimed by Smith in his specification, and as limited to the "dead-wood," by a memorandum of alteration, afterwards enrolled, was new, (see *Mech. Mag.*, vol. xxxix., p. 294,); and 2nd, whether it was in the dead-wood that the defendant had fixed his screws? An objection was taken for the defendant to the legal validity of the memorandum of alteration enrolled by Smith, but this was reserved by the Court, for future determination. The other issues went to the Jury.

A number of witnesses for the defence were examined, who stated that so far from the screw being fixed in the "dead-wood" which is afore the stern-post, it was applied and fixed abaft the stern-post, in accordance with the specification of a patent, known as Cummerow's patent. Several other patents were also put in, to show that Smith's was not an original invention of the screw. One was the patent, taken out in 1794, by Lyttleton, (see *Mech. Mag.*, vol. xliii., p. 353,) another was that of Cummerow's, in 1828; and a third was Woodcroft's, in 1832, all for screws to propel ships.

The LORD CHIEF BARON, in summing up, observed that the great question was, whether where a vessel had been lengthened out beyond the ordinary "dead-wood," as in this case, and had had the screw fixed into that elongated part, that application could in truth and fairness be considered as a violation of Smith's patent?

The jury found—first, that the screws in the vessels named, were not fixed and worked in the "dead-wood;" and, second, that there was not a colourable evasion of Smith's patent in the mode by which the screw was applied to the said vessels.

The LORD CHIEF BARON then directed that the verdict should be entered for the defendant on the first issue, and for the plaintiff on all the others, giving leave to move upon the point reserved.

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*The "dark unfathomed caves of Ocean."*—Mr. Mackain, C.E., in a paper in the *Glasgow Philosophical Transactions*, states some strong reasons for believing that water is as compressible as air under the application of *proportional* forces; and assuming it to be so, he concludes, that bricks might be found floating at a depth of 28,330 feet; granite at 56,000 feet; and cast iron at 200,000 feet, or 39 miles.

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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1172.] SATURDAY, JANUARY 24, 1846. [Price 6d.

Edited by J. C. Robertson, No. 166, Fleet-street. Double.


## FIRCHILD'S PATENT VEGETABLE CUTTING MACHINE.

Fig. 1.

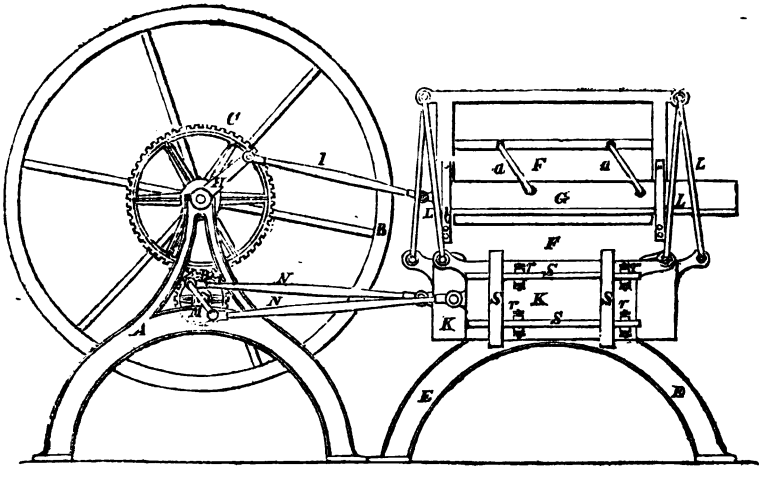



Fig. 5.

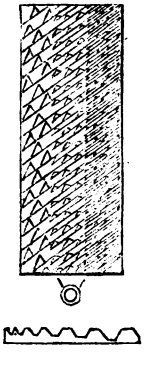


Fig. 4.

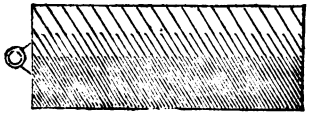


Fig. 2.

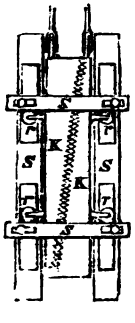
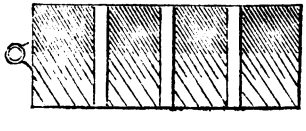



Fig. 6.



## FIRCHILD'S PATENT CUTTING, SLICING, GRINDING, AND RASPING MACHINE.

[Patent dated May 29, 1845; Specification enrolled November 29, 1845.]

Fig. 10.

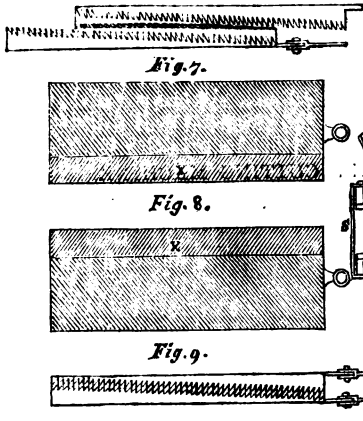
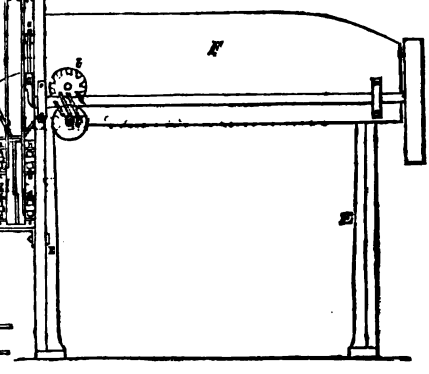


Fig. 7.

Fig. 8.

Fig. 9.

Fig. 3.




THE principl object apparently aimed at in the construction of this machine, has been to furnish the agriculturist with a ready means of reducing gorse or furze to an edible state. Although this shrub is known to furnish an excellent food for cattle, and grows wild in vast abundance all over the country, it has been hitherto but little used for the purpose, in consequence of the prickles in which it abounds, and of the inadequacy of any of the existing vegetable cutters to crush them sufficiently. By the present machine the roughest gorse can be reduced to a mass as soft as hay, and by its general adoption the same effect will be produced as if some two or three hundred thousand acres of the finest pasturage were at once added to the agricultural resources of the kingdom. But though gorse cutting or bruising be the chief object of Mr. Firchild's machine, it will be found equally adapted for the cutting, slicing, grinding, and rasping of all sorts of vegetables. We extract the following descriptive particulars from the specification of the patent.

### *Description of the Engravings.*

Figure 1 represents an end view of the whole of the machine, and fig. 2, a side view of the parts by which the cutting, slicing, grinding, and rasping are effected. A, is a standard, or frame, which supports the driving parts of the machine. B, is a fly-wheel; C, a cog-wheel, fixed on the shaft of the fly-wheel; D is a spur-wheel, which takes into C; E is a second standard, or frame, which supports the parts of the machine by which the cutting, slicing, and grinding, or rasping, are effected; F is an open-feed box, from which the article to be operated upon is supplied to the blade, either by hand, or by an endless feed cloth, or by two grooved-feeding rollers, as shown at *t t*, in the engraving. G is a cutter, which is suspended by two links, *a a*, from the front of the feed-box, and kept close up to it by the guides, *b b*; H is a crank, attached to the end of the fly-wheel shaft, and connected by a rod, I, to the cutter G, so that as the fly-wheel revolves, it imparts to the cutter, not only a reciprocating, but an alternately rising and descending motion, whereby it operates with much greater power and freedom than the cutters of ordinary machines of this class, and whereby, also, time is allowed after each stroke for the cut-off material to escape before the return of the cutter, and all choking of the machine is thus prevented. K K, are two parallel graters, or rubbing surfaces made of toothed iron, millstone, or other suitable material, which are grooved or toothed on their inner surfaces (as shown separately in figs. 4, 5, and 6,) and move to and fro in the hanging bearings, L L, as they are acted upon by a double crank, M, attached to the end of the shaft of the spur wheel, D, and between which the cut material falls from the cutter, G, in order to be ground or rasped.

Fig. 6 shows three recesses as well as teeth cut on its surface; these plates or surfaces are kept together by the friction rollers *r r r r*, acted upon by the adjusting-frame, *s s s s*. In cutting gorse, care must be taken to adjust the cutter to such a gauge that it shall be cut into small pieces of not

more than, say from an eighth to half an inch, or thereabouts, in length. When the material is of such a nature as not to require any further comminution than it receives from the cutter, the plates, KK, may be thrown out of work by unkeying the connecting rods, NN. And, in like manner, when the material is desired to be ground and rasped only, the cutting part of the machine may be detached by unkeying the connecting rods I. Figs. 7, 8, 9, and 10, represent two improved grinding plates, made wedge shaped, and fitted with a parallel piece, X X, at the bottom of each, so that the movement of the surfaces in different planes causes the toothed and wedge formed surface of each plate to recede from and approach towards the other alternately during the progress of the stroke, assuming the positions shown at figs. 9 and 10 at different parts of the stroke, and thus opening as it were, or separating to receive a charge of material from the cutter, or hopper, at one moment, and closing upon it at another to grind or crush it. The plan of a pair of these plates as applied to the machine is given in fig. 11.

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MISCELLANEA MATHEMATICA—NO. 3.

*On Horner's Approximative Process.*

The *rationale* of this process, for approximating to the roots of numerical equations, has been given with great perspicuity and simplicity in a former volume of this work, by our able correspondent, Mr. Gray, (vol. xl. March, 1844;) and the examples which he has selected for illustration are chosen with much judgment. We are led to hope, th those of our readers who take an interest in this important problem, and who have not access to the larger and more modern treatises on elementary algebra, have derived some advantage from the study of those papers, and rendered themselves familiar with the practice of the method. We have, indeed, occasionally opened our pages to speculations on other modes of treating the problem, under the hope that (though we believed that no process could supersede Horner's) some curious and interesting properties of the *literal equation* might be elicited by our correspondents. That hope has not been fully realised; and we shall, unless results strikingly original are offered to us, discontinue these subjects in the *Mechanics' Magazine*.

The author of that paper having taken, as he states, Professor De Morgan for his guide, we may at once infer that he is upon safe ground: as in such matters, Mr. De Morgan is not only a competent, but a high authority. At the same time, he entertains an opinion on a question of history in respect to this process, from which we altogether dissent: viz., that Horner's method is only an extension of that of Vieta and the earlier algebraists. Mr. Gray adopts the same view, vol. xl., p. 148, foot-note. Upon this opinion we shall offer a few remarks; and we do it with the sole desire of placing the question in what appears to us to be its true light.

Was it with Vieta that the approximation to the value of $\sqrt{2}$ originated? Did the idea of approximation at all originate with Vieta? If the conception of approximation to the value of $x$ in $x^2=2$, did not so orignate, neither did that, of approximation to $x^2+ax=b$. The extension of this view was *natural;* but, still, from the limited views entertained at that period by algebraists, respecting their own tools, it was not an easy thing to extend it *practically*. We accord at once all that is claimed for Vieta, with this understanding—that the fundamental idea of approximation is not his. To find a near value of a root, and transform the equation by it, (or, more correctly, diminish all the roots by it;) to find a near value of the *corresponding* root of this transformed equation, and again diminishing the roots by this value; and soon to any required extent; this is the essential character of almost every mode of approximation—or at least, it bears a more or less close analogy to every one. The method of "trial and error," and the processes of Raphson and Newton, are specimens.

Mr. Horner laid no claim to this principle—it was universally recognised—and it forms no special part of his method, more than it does of almost all other methods. The only claim that he made, or that has been made for him, is *the* sole invention of the *process of transformation itself*. On this alone do his claims rest; and whoever attributes to him other claims on this part of the subject has altogether misunderstood him: but in this, we consider his claims to stand altogether unimpeached and unimpeachable.

The term *involution* used by Professor De Morgan and Mr. Gray appears to have been selected more from the parti-

cular accident of the part of the *Penny Cyclopædia*, into which the first-named gentleman was prepared to introduce the subject, than as descriptive of the process of gradual extraction. A more appropriate term, no doubt, would be *evolution*; but, instead of discussing mere terms, we would rather express the obligations which numerical computers are under to that distinguished mathematician, for his elaborate elucidations of the history, theory, and practice of evolution. We believe that it was not his intention to write a mere *class-book*, when he composed the several articles on this and collateral topics for the *Penny Cyclopædia*, or the *Companion to the Almanack*; but rather to render the subject intelligible to mathematicians, both as to principle and praxis. In this he has beyond all question, succeeded.

It ought to be remarked, that the process under consideration is only one of several, which Mr. Horner devised for the purpose of approximating to the roots of equations; all, however, having one common principle. It is neither the most expeditious nor the most recondite; but it has the advantage of exhibiting *all* the work, and from the continuous uniformity of its steps rendering a mistake, (except such as all calculations are exposed to, from abstraction of the attention,) altogether impossible. We think, therefore, that the expositors of the method have shown good judgment in the selection of this particular form of the process; though we still feel it necessary to inform our readers, (and, apparently, most mathematicians,) that it is only the second in generality, out of four different forms of the work.

Other processes for transformation made their appearance soon after Mr. Horner's paper was printed in the *Philosophical Transactions* for 1819. Some discussions of a personal, and rather angry character arose out of claims set up by these post-discoverers. The disputants were Messrs. Atkinson, Holdred, and Nicholson—all of whom put in claims against Horner. That question was soon settled, and if any doubt were affected by the captious, the elucidations of the history and principles of the several processes by Mr. De Morgan gives to *them* a *quietus*. We only urge in opposition to the historian, (as we understand him,) that Mr. Horner did not claim one jot in reference to this invention beyond that of the *modus operandi* of approximating, and the development of the principles on which it rests.

Of the systematic writers on the subject of *numerical solution*, Professor Young, of Belfast, is unquestionably the most elaborate and complete. His "Theory of Equations" is a classical, and will long continue to be the standard book on the subject. The first edition was published in 1835: but it has since been much enlarged and improved—whilst a smaller volume on "Cubic and Biquadratic Equations" supplies the place of the original work as a class-book. To the purposes of the majority of our readers this latter work is well adapted.

About the same time a sketch of the method was published by Dr. Gregory in the eleventh edition of Hutton's Course, furnished, (as the preface informs us,) by Mr. Davies; but this, we have been informed, encountered the most intense opposition on its introduction into the Royal Military Academy! That sketch, somewhat modified, still forms the article "Equations" in Mr. Davies's own edition of Hutton: which, from its combination of conciseness with generality, is calculated to be of use to the student who pursues a regular course of analysis.

Dr. James Thompson, of Glasgow, has also introduced the subject into his algebra; but we do not altogether approve of the "free use" which he professes to make of the writings of others, without at least doing them the justice of stating to whose and to what works he refers. We have ever disapproved of this species of literary pilfering—it is unworthy of a man holding the professional position that Dr. Thompson does.

Mr. Nicholson (whose conduct in respect to this problem might have been more freely remarked upon had he been alive to justify himself) published the same process as the usual one of Horner, as a supplement to *Rowbottom's Algebra*, many years ago. This work has had many new title-pages bearing the impress of new editions; but it is a very imperfect development, and scarcely deserves notice, except to caution our readers that it will not be at all adequate to their wants. The somewhat clumsy method of development employed by Nicholson has been adopted by Professor Christie in the first volume of his *Course of Mathematics* for the use of the Gentle-

men Cadets of the Royal Military Academy; but with such a strangely confused notation, and jumbled reasoning, that to us it appears altogether incomprehensible—what, then, must it appear to the student, to whom the subject itself is new? The strangest part of the business, however, is, that this gentleman affects to be labouring under the unaccountable delusion that *his* process is original! No — stranger still —that Mr. Weddle had somehow or other surreptitiously obtained the professor's method, and published it as his own four years before the professor's "Course" appeared! At least we can find no other interpretation of those very atrabilarious effusions which appeared at p. xi. of his preface, and in other parts of his book.

Mr. Weddle's essay is a most remarkble one: inasmuch as his method is *strictly and truly original* in conception and character; and that to many conceivable cases it is *the only one that can be applied.* He altogether departs from the usual plan of diminishing the roots of the equation; and finds his root in the form $x=r(1+r_1)(1+r_2)\ldots(1+r_n)$ . . . . . ; which from the continually diminishing value of $r, r_1, r_2, \ldots r_n \ldots$ is completed with great facility. For equations having their coefficients numerous and different from 0, this method is of inferior facility to that of Horner: but when there are but few actual coefficients, it is of superior efficiency—no matter how high the degree of the equation—as this method does not re-introduce coefficients in the course of the process, like *all the other methods.* Its originality and its great value of meeting exigencies in calculation, otherwise unprovided for, did not constitute sufficient merit to obtain for it a place in the *Philosophical Transactions;* and the author, in order to his not being "burked" in the usual way, was compelled to publish it at his own expense. We should l[illegible]e to know who "reported" on this p[illegible]per, and what the nature of that report w[illegible]s. Rumour says curious things about [illegible]—to wit, that it was either strangely misrepresented or still more strangely misunderstood, by the "referee" of the Royal Society's Council.

It was announced seven or eight years [illegible] that Mr. Horner's papers would be [illegible]blished by Professor Davies; but if [illegible]h publication have taken place it is known to us—and in fact it appears from the passage in Professor Christie's preface, that this has not been done. Why? Surely *they* are worthy of public notice; and the public is entitled to the benefit of such a mind as his. We do, indeed, observe that his rejected paper of 1823 is in course of publication in the *Mathematician;* but it appears in such small sections, and at such distant intervals, as to more resemble the cup of Tantalus than a refreshing draught of the living waters of genius. We are the more surprised at this from seeing Mr. Davies's name at the head of the managers of the work, and naturally inferring that he might have given the entire paper in the course of the first *guinea volume.* We would fain hope that he is not growing lukewarm in this cause; or, even if he be, that we may be able to reanimate him in the cause alike of science and of friendship!

## PERPETUAL PENDULUM.

Sir,—By means of a galvanic battery and the instrument which I am about to describe, a pendulum may be kept in constant motion, *without any friction whatever* in the changing of the direction of the current. Now this is an advantage desirable for an electric clock, and for other combinations; but the purpose to which I apply it is, in connexion with a barometer and thermometer, to register the weight and temperature of the atmosphere *for every hour of the day,* if necessary, and *that* without being inspected, except at long intervals, say once a week. The arrangement by which these registering instruments are made thus automatic, I may describe in another communication, as well as the means which I use to obtain a magnetic force, absolutely constant under all changes, and equally applicable to the maintenance of an invariable magnetic force in any other machine.

Fig. 1 is a vertical plan; fig. 2, a ground plan of the instrument, everything being represented that is necessary to render the action intelligible. A, is a magnet attached to the end of a pendulum, A B, the upper end of which, beyond B, is of soft iron, and oscillates between two electro-magnets, *k k.* The pendulum is kept in motion by the alternate action of *k k,* and to render them polaric alternately, the bar, *a, b,* which is free to move horizontally on the arms, *c,* has,

Fig. 1.

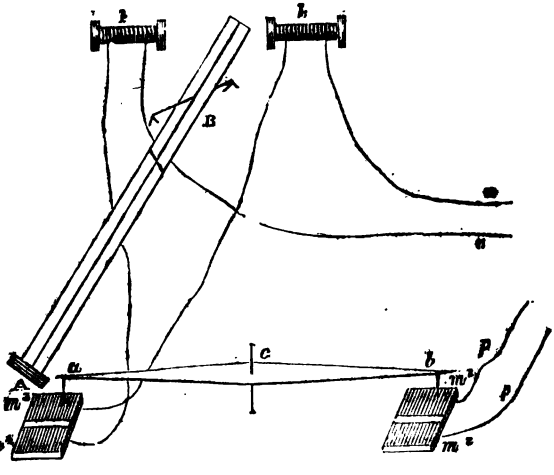



Fig. 2.

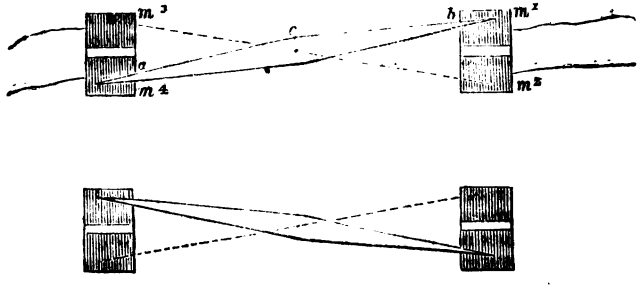



Fig. 3.

at each extremity, points dipping into the mercury cups, $m^1$ $m^2$ $m^3$ $m^4$, the shaded parts representing the mercury, and the partitions between $m^1 m^2$, and also between $m^3$ and $m^4$ hanging so low as to permit the points, *a b*, to pass over it.

Let the wires, *p p*, *n n*, be in connexion with the positive and negative poles of a galvanic battery, and the pendulum set in motion.

When the magnet, A, arrives opposite to the end *a*, of the bar *a b*, it will attract it, and the points will be in the mercury cups, $m^1$, $m^4$; thus it will be seen, that the electro-magnet, *k*, will become polaric, while the magnet, *k*, will cease to be so.

The pendulum will then oscillate to the opposite side, and when A comes to *b*, the bar, *a b*, will move so as to complete the connexion of *k*, and break that of *k*; in this manner, without any friction whatever, except the necessary but constant friction at B, the pendulum will be kept in motion. A bar exactly similar to *a b* vibrates on the other side of the pendulum, as represented in fig. 2; this makes the attraction on A to be symmetrical; but its use is connected with the registering part of the instrument, and shall be therefore explained when I describe that other, indeed the only important part of it.

I am, Sir, your obedient servant,

J. M.

Dublin, January 14, 1846.

## THE PROPERTIES OF THE SCREW PROPELLER CONSIDERED, AS SHOWN BY THE RESULTS OF THE RUNS OF THE GREAT BRITAIN, WHILE CROSSING THE ATLANTIC. BY COMMANDER HOSEASON, R.N.

Sir,—The important part steam is likely to perform in the event of a future war, makes every experiment connected with this subject of interest to the public; feeling this, and knowing the extensive circulation of your journal, I am induced to send to you the following observations, confident, that if they are deemed to be written in an impartial spirit, they will find a ready insertion.

When experiments are obtained on an extensive scale, as those supplied by the above-mentioned steamer, it is not by any means difficult to a person, conversant with his subject, to arrive at a tolerably correct conclusion, and I shall endeavour to place the matter in that clear light, that all, however little they may be acquainted with the subject, shall be competent to judge for themselves. Most sanguine expectations were formed of the anticipated runs of the *Great Britain* across the Atlantic; it was given out by those interested in that steamer, that her performances would be found to surpass those of the *Great Western*, or any, or all, of those beautiful steamers which pass under the appellation of Cunard's line. How far these sanguine expectations have been realized, it shall be my duty to show; and, moreover, I will clearly prove, that the *facts* obtained from the various experiments carried out by the Government and other parties, never justified any such sanguine anticipations, but ought inevitably to have led to the conclusion, that the screw (at least in its present shape) was neither an effective, nor an economical propeller. It is a fundamental law of mechanics, that no interposition of machinery can add to power, although from friction, or other causes, it may detract from it; the consequence, then, is clear, that the sole consideration which ought to influence our judgment, in the selection of this or that propeller, is this,—which produces the greatest useful effect from a given quantity of steam; for the steam *alone* is the power obtained by the combustion of a given quantity of fuel. And there is another law not less immutable—*that the generation of steam is in a direct ratio with the consumption of fuel*; so whenever we read of a saving of one-third, one-half, or one-fourth, of steam, we may instantly understand that to mean, that a saving to nearly an equal extent may be made in the fuel. In all trials of the screw, under similar circumstances with the paddles, it has been evident what an inferior propeller it is; and it will be seen by any party who chooses to look into the Appendix to Tredgold,—where will be found the recorded experiments of the "*Bee*," Government steamer, fitted to work both screw and paddles,—that while the former, from 42 revolutions of the crank, only gave a velocity to the steamer of $6\frac{6}{10}$ths miles per hour; 32 revolutions of the crank with the paddles gave a velocity of $7\frac{6}{10}$ths. It shows an inferiority of speed, as obtained by the screw, of $\frac{7}{10}$ths of a mile per hour, while at the same time we perceive a considerably greater consumption of steam, the fuel for the revolutions being as 42 to 32; and, therefore, we may consider, for the sake of simplicity, the revolutions to represent the quantity of fuel in cwts. So then, the screw from 42 cwts. of fuel, only gave a speed equal to $6\frac{6}{10}$ths; while the paddles, from 32 cwts. of fuel, gave $7\frac{5}{10}$ths. The trials of the "*Rattler*" and "*Alecto*" will be found to establish the same important *fact*, that when equal portions of fuel were taken, the screw was never able to give an equal propelling power; for it is a notorious *fact*, that, although the "*Alecto*" and "*Rattler*" were said to be the same in *nominal* horse-power, the *real* power, as obtained by the *Indicator*, showed a difference of at least one hundred horses in favour of the *Rattler!* Not content with this advantage, the "*Alecto*," an old steamer, was brought down in the water to a line of immersion the least favourable to her, or five inches deeper than she had ever been brought to, during the five consecutive years she had been in commission; to effect this, although of eighty tons *less* burthen than the "*Rattler*," she was required to take eighty tons more weight on board, in the shape of ballast, coals, water, &c., &c. And then, of course, as the line of immersion was changed, the paddle floats were forced to be reefed, thus reducing the effective leverage of the paddle-wheels, while, at the same time, the resistance consequent on an excess of immersion was increased.

Thanks, however, to the *Times*, from

the admirable nautical data, now nearly daily supplied, we shall ultimately arrive at the truth. The data to which I at present allude is the abstract of the log (published in the *Times* of September the 17th) of the run of the *Great Britain* in her homeward voyage from New York; from this abstract we deduce the important *fact* that, although crossing the Atlantic under most favourable circumstances, this steamer did not give a mean average velocity of more than 8$\frac{4}{10}$ths nautical miles per hour, which is nine-tenths of a mile per hour less than Cunard's line of packets gives, from a mean taken of the runs of all the boats, over two entire years, of both winter and summer voyages inclusive, and also less than six-tenths of a mile per hour than the *Great Western* gives from a mean deducted from both outward and homeward voyages, over an equal space of time. It is well known that the homeward voyage is, on an average, performed in about two days' less time than the outward; what then may fairly be anticipated will be the performance of the *Great Britain*, when a mean average velocity from equally unfavourable circumstances is taken?

But a more severe charge is yet to be clearly established against the screw. It is affirmed, and I believe with truth, that whatever the velocity of the screw steamer may be *through the water*, the velocity of the engines is required to be kept at a maximum, or nearly so; so that a screw steamer's engines will be found to consume nearly as much steam in a gale of wind, while the vessel is only going *two* knots per hour, as they would in a calm, when propelling her *ten* knots!!—Not so the paddle-wheel steamer's engines; for it is known that the consumption of fuel is nearly in proportion to the work done. A screw steamer's ability to cross the Atlantic will, therefore, often depend upon the accident of weather; while the paddle-wheel steamer will complete her voyage, for what is lost in time is saved in fuel. Various are the reasons assigned for this defect in the screw propeller, of which the most probable, I conceive, to be a deficiency of propelling surface or area of the screw, which requires it to be driven at very high velocities to create a sufficient *fulcrum* in the water.

Here I had originally concluded the letter which I have now the pleasure to forward, and it would have appeared in the columns of your Magazine immediately after the publication of the log of the run of the *Great Britain* on the first homeward voyage, and about the same time that I did myself the honour of forwarding to a member at the head of the Board of Admiralty the conclusion to which I had arrived consequent on the data published; but it was suggested to me to wait for still more conclusive data, ere I again availed myself of a public channel to convey such views. In the letter mentioned above, I stated that, despite the slow speed of the *Great Britain*, as proved from her own logs, I felt assured that her consumption of fuel would be found to have been enormous, and suggested the propriety of sending for the log of the *Great Britain*. The same, like every other suggestion I have had the honour to make, was instantly attended to, and the logs of the *Great Britain* were officially written for; and I will stake my credit upon the truth of the prediction, although I have made no application for a perusal of the same.

The *Great Britain* again left Liverpool, on the 27th of September. In the columns of the "*Times*," I read that she had been spoken with on the 7th of October, by one of Cunard's boats; the latitude and longitude proved that she was only half across the Atlantic, although ten days out; I then put upon paper the opinion, that if she took eight days to perform the other half, she would possibly be run out of fuel; but if she took ten days, certainly the fuel would fall short. The result turned out even worse than I anticipated, for at the end of sixteen days, she had to bear up for a port called Holme's Hole, 200 miles short of New York, having been entirely run out of fuel, after having consumed the enormous quantity of 1050 tons, or at the rate of 63$\frac{1}{2}$ tons per day. —Vide *Mech. Mag.*, November 1, 1845.

A new and important feature militating against the screw, as fitted for ocean navigation, has, by the voyages of the *Massachusetts*, (or *Marmora* steamer,) and the *Great Britain*, been dragged to light. The *Massachusetts* had her screw doubled up like a pancake, by a blow of the sea, just two days after she left her port; and the *Great Britain* lost all the arms of her propeller in the last outward and homeward voyages. The

reason assigned for the accident to the first of these vessels, was, that the screw was made of copper. But I should like to hear the cause assigned for the same accident to the latter; seeing, as I believe, her screw was made of wrought iron, and of the enormous weight of 77 cwt., or 3 tons 17 cwt. As a practical *seaman*, it strikes me, that the cause might be, that when the vessel *pitched* deep, the screw was raised entirely out of the water, which enabled the engines to run off with a frightful velocity, (as it is notorious that the screw of the *Rattler* has been seen entirely out of the water, cutting capers like a whale with its tail,) and then, when the vessel took a *tend aft*, the engines, screw and all, were brought up standing, that is, suddenly arrested, consequent on the deep immersion of the screw.—What a pleasant charge a pair of such enormous engines must be to the working engineer, when the tail of a steamer, during a heavy gale upon a lee shore, leads him such a dance!

The *Dwarf* steamer has the immense power of 90 horses, while this yacht is but 160 tons burthen; and yet, after a trial of 22 screws, the maximum velocity obtained is but 9½ knots per hour. I ask engineers, what they think of such a *fact*?—The "*Rattler*" has tried 14 screws, in the vain hope of obtaining the same velocity as the paddle-wheel would give.

The *Phœnix* used, when her engines were in good order, with the paddles to give a *mean* average velocity at sea of nine knots per hour; but now, since the horse power in this steamer has been increased sixty (nominal) horses power, we find her *greatest* speed in the river Thames is only 7$\frac{8}{10}$ths.

I mention these *facts* for the benefit of those members of the House of Commons who talk with great volubility upon a subject which, evidently, they do not understand, when they blame the Board of Admiralty for not adopting, universally in the service, a propeller, which, as far as an appeal to practical *facts* go, seem to render a steamer for ocean navigation next to useless.

It will be seen that I have not touched upon the question, as to the advantages of the screw as a *mere* auxiliary, as the demonstration of its inferiority as a propeller has already drawn me into great length.

But it must not be inferred from this, that I have not carefully considered the subject, in every possible bearing the argument may take. In the *Naval and Military Gazette*, of June 26, 1841, I treated upon the general question, as to the ability of steamers to oppose line of battle ships, and frigates; and, in seven closely printed columns, denounced the then false armament of our steamers; that armament has since been abandoned, and one I hold infinitely more advantageous has been adopted.

Everything that can be said in favour of the screw is a *prima facie* argument; not so the objections to be taken, as a perusal of the above letter will sufficiently demonstrate.

All that I contend for is, that whenever the screw is adopted, it ought to be with a fore-knowledge of every practical objection that can be raised; and to meet this question fairly, we ought to find united in the same argument an intimate knowledge of the principles and action of steam; the science of gunnery; and last, although not least, the profession of a *seaman*. I have the honour to be, your obedient Servant,

J. C. Hoseason, Commander, R.N.

Army and Navy Club, St. James's-square, 26th November 26th, 1845.

P. S. The objections taken by me against the *Great Britain* are not the only ones that can be raised—for fault is found, with justice, I conceive, to the construction of the engines; and, consequently, some portion of the great expenditure of fuel in that steamer may be traced to that source. The slide or *fixed* expansion (I use the latter word in contradistinction to the separate expansion gear under control of the captain, which can be altered at discretion,) cuts off the steam too soon, and thus attenuates the steam too much. There is a happy medium in all things; and the constructors of the *Great Britain's* engines do not appear to have hit upon that medium. As this point is very lucidly explained by my friend Lieutenant Gordon, R.N.,* I shall merely quote the passage, and let him speak for himself:—

* The Economy of Marine Steam Engine Further Considered. By Lieut. W. Gordon, R.N.

"It has been stated, that the *Great Britain* is fitted to cut the steam off at *one-sixth* of the stroke; and if the maximum steam pressure in her cylinders does not exceed 20lbs. per square inch, there will be a loss incurred by cutting off so early. To illustrate this point, it may be assumed that the friction of these engines when unloaded, and including the friction of the propeller, cannot be less than 3·5lbs. per square inch of the pistons; and the uncondensed vapour being 1·5lbs., the total resisting force due to to the motion of engine *alone* will = 5lbs. per square inch. The cylinders are 6 feet long, consequently, if the steam is cut off at 1 foot from the bottom, its elasticity will be reduced to *less* than 5lbs. per square inch when the piston has travelled through 4 *feet of its stroke*, and the power *wasted* in performing the remaining 2 feet will be about 1lb. per square inch raised 2 feet high. Thus, when the piston has performed two-thirds of its stroke, the *whole amount* of duty will have been given out by the steam; and the utmost limit of *useful* expansion will be obtained in these engines (with a maximum steam pressure of 20lbs.), by cutting off at *one-fourth* of the stroke."

I think it is as well for me to state distinctly that I agree entirely in the propriety of fitting the steam guard-ships with the screw propeller. And no doubt, there are some few cases where the screw will be advantageous as an auxiliary for ocean navigation; such as vessels expressly intended for the suppression of the slave-trade (this, however will militate against their *general* efficiency;) but for transatlantic navigation, particularly the North Atlantic, it can never, in my opinion, be adopted but to the detriment of the service.

## DELL'S PATENT HYDRO-PNEUMATIC BED-WARMER.

The construction of this ingenious and useful domestic apparatus will be readily understood by reference to the engravings, fig. 1 being an external, and fig. 2, an internal view. It consists of a perforated metal cylindrical case, A, containing another cylindrical case, or tube, B, but made without perforations, so as to contain hot-water, which may be poured in at the end C, where a wooden handle is attached to a suitable metal-screw plug. This hot-water cylinder, B, is suspended within the case, A, leaving a space all round for the circulation of air.

To use this apparatus as a bed-warmer, unscrew the brass nut by turning the handle, C, then take a tin funnel, or pour at once directly from a kettle, sufficient hot-water to fill the tube, which will now act as a heater; screw in the handle, and place the whole apparatus within, and at the foot of the bed, or wherever it may be wanted. Its operation is now simply this, all the air that passes through the lower perforations of the outer case coming in contact with the hot-water heater is suddenly expanded, and escapes from the upper surface of the cylinder, and so on continually, as long as the water retains its heat. The consequence of this constant breathing forth (as it may be called) of temperate warm air, is, that not the feet alone, but the whole person, becomes enveloped in a *bath of warm air*, the agreeable effect of which is speedily felt by the warmth

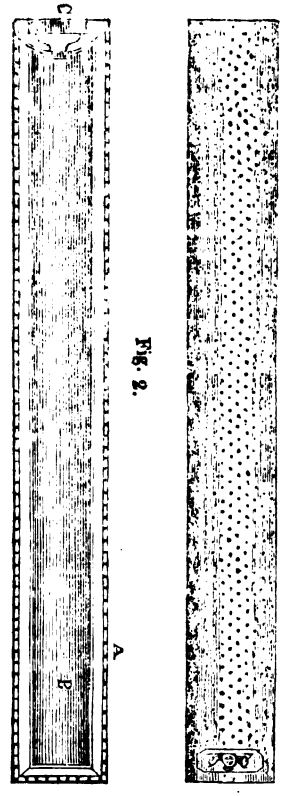



Fig. 2.

Fig. 1.

experienced about the neck and shoulders, so remarkably different in effect to any other mode of bed-warming ever hitherto adopted, as to amount to an absolute luxury; it must, therefore, prove highly beneficial to travellers, and will, no doubt, be extensively patronized by hotel keepers; but to invalids it will undoubtly become indispensable, the faculty highly approving of the genial warmth it diffuses, throughout the entire night, with little apparent diminution of energy, insomuch, that in the morning the water poured from the apparatus is found at a suitable temperature for washing.

In cold climates, and indeed at any inclement season of the year at home, and for use on board ships, in railway and private carriages, whether in health or in sickness, an apparatus of this nature is a most acceptable accompaniment, becoming then, not more a matter of comfort than necessity.

We have here only described the apparatus as constructed for warming beds, but it is being manufactured in every variety of form, and for very different uses, as for feet warmers, and to be used as hot-water stoves in nurseries, boudoirs, &c., and will be found desirable in sitting-rooms at those seasons of the year when warmth is required, although at the same time the heat of a fire or common stove is found to be oppressive.

## SHIP RAILWAY OVER THE ISTHMUS OF SUEZ.

From the first entertainment of this project it has been stoutly asserted that the natural obstacles that oppose its construction are somewhat imminent. Sir William Harris,* in his opinion on the subject, showing at the same time the ease of its accomplishment at infinitely less expense, and by a much less complicated process than a canal, as also in a much briefer space of time, states that the line over which the rail must pass, far from being beset with difficulties to the engineer, has been ascertained to present a very favourable profile; and a hard gravelly soil is known to prevail in lieu of the shifting sands of the desert, which were skilfully conjured into existence by a faction whose theory was to arrest the progress of the plan.

The rails of the proposed road being laid down, the next exigent in the case is the special order of engine to be frabricated to adapt itself to the peculiar necessities of the case. For this purpose it is proposed to construct a class of narrow steam vessels of about 800 tons burden, suited for freight, and to transport them across the Isthmus of Suez upon trucks, by means of locomotive engines of adequate power. The vessels would advisedly be built upon the plan that will best serve to counteract any additional strain upon the sides involved by removal from the water, and the cradle truck upon which each will be placed during the transit would be constructed with the same view.

The most eligible point to which the railway could be carried, is of course determinable solely by the geographical character of the surrounding and adjacent country. The Nile and Cairo is clearly the point indicated for this purpose. Here the laden steamers might be transferred from one to the other of the divided seas, through its always navigable channel.

The inaccessible character of the Mediterranean shore lying over against the sea of Suez, and the general unfitness of all the ports or roadsteads on that coast for vessels of any considerable draught of water, render it almost unsafe to regard any other point as available.

Owing to the peculiarities of the situation the engineer will have to look to the ordering of some few *minutiæ*, which we shall specify at the end of our description. With regard to the locomotive power necessary, it appears, in the opinion of judges on the spot, that the engines required to draw a laden vessel of 800 tons burden across the desert of Suez would not need to possess above three times the power of those ordinarily used upon an English railway; and the increased disposable breadth for the machinery would render this power one of easy acquisition. The masts of the vessel would have to be so constructed as to fold over and lie flat during the transit, in order to prevent any action of the wind upon them, and a moderate width between the rails

* Sir William Cornwallis Harris, major of engineers of the Bombay establishment, so far back as 1830, during the administration of Lord Clare, was nominated by his lordship to the Bombay Government, who had instructed him to select an officer to conduct a survey of the Isthmus, in view to the execution of a navigable canal then in contemplation, although subsequent political events unfortunately set this project aside. He had meanwhile diligently collectedinformation on the subject about to be confided to him, and when returning through Egypt from the mission, with which he had been intrusted to the Court of Shoa, in Southern Abyssinia, he enjoyed an opportunity of studying on the spot the facilities presented towards a project, important alike to the interests of Europe, and to the advancement of the Eastern Empire, over which the East India Company preside.

would then be found sufficient. A station, or siding, to admit of vessels on their trucks passing each other midway, would also have to be constructed in the centre of the line; and, as the entire distance of eighty-four miles could be accomplished in four or five hours, communication between Suez and Cairo might be daily held each way upon a single line of rails.

A million sterling, then, in conclusion, is the outside sum at which this very noble project could be carried out. This sum falls very far short of the lowest estimate that has been framed for a ship-canal, and it may appear a small sum for so long a line as that in contemplation; but it should be borne in mind that the ground has not been purchased, that there are neither bridges nor tunnels to construct (both of which are amongst the heaviest items of an English railway), and only one line of rails will be required. The railway might be completed in two years, whereas the construction of a canal, supposing it to be within the compass of human exertion, would occupy ten. Commercial interests generally cannot fail to be materially promoted by this mode of transporting cargoes across the neck of land which disconnects Europe and Asia; and it must proportionably improve the revenues of his Highness the Viceroy of Egypt. It is always observed that the operation of a railway is to treble the traffic upon a new line; and the improved relations with China, as well as the success of a new branch of commerce on the eastern coast of Africa, will both tend to swell the importance of the plan suggested. Recurrence also may here be made to the highly important subject of the coal beds which have been reported to exist within a reasonable distance of the coast of Abyssinia, in a position the most convenient for the supply of the depôts both at Aden and Suez.

The plan, when carried out, will certainly in those distant and comparatively untravelled regions, produce a new era of commerce, and wider fields for the spread of civilization, philanthropy, and intelligence.—*British and Foreign Railway Magazine. No.* 1.

THE SUGAR MANUFACTURE.—APPLICATION OF ATMOSPHERIC AIR TO FACILITATE THE CONCENTRATION OF THE SYRUP.

Sir,—The scientific propriety, as well as practical efficacy, of the method of employing atmospheric air to concentrate the cleansed liquor or syrup, in the manufacture of sugar, which is now coming into extensive use in the West Indies, (for which method I have a patent,) having been coarsely impugned in certain publications which are in private circulation, and which may have found their way into quarters which, being unknown to me, must be beyond the reach of any antidote which I could privately apply to the calumnies of the writer, I hope that you will, in justice to a most useful invention, (in my humble judgment,) and for the sake of the too long suffering West India interest, allow me a brief space in your universally read pages, to place its merits in their true position before the public.

The operation referred to is performed in an open pan or chest, having a coil, or series of pipes therein, in which steam circulates, such medium of heat being preferable to a fire under the pan; in which sort of pan the method was first employed, and is available. Air is forced into a wheel resembling a coach wheel; the nave and spokes are made hollow, with perforations therein, for the egress of the air; and by the slow rotation, the wheel suspended in the pan near the bottom, the air that escapes is uniformly diffused into the syrup under the influence of heat, and the syrup is thereby concentrated at the desired *low* temperature to the degree for crystalizing.

The same description of pan, or chest, is employed, (the air apparatus being dispensed with,) for concentrating the syrup at the usual *high temperature* by the heat of *steam alone*, (the subject of another patent;) and thus by substituting the heat of steam for fire, the *carbonization* of the syrup is greatly *lessened*—the operation much *quicker*—and consequently the quality of the *sugar improved.*

For defecating the cane juice, and also for subsequently cleansing the liquor, and evaporating it to the degree for final concentration by either method, pans or chests similarly constructed are used, and those operations are performed better and quicker by the heat of steam, than by the ordinary mode of fire under the defecating and evaporating pans.

The advantages of concentrating saccharine solutions at a *low* temperature have for upwards of thirty years been exemplified by the use of the vacuum pan in refineries of sugar. The products of sugar are greater, from a given weight of raw material, and the quality better, and a less quantity of treacle or molasses

is obtained. Therefore, any method by which syrup can be concentrated at a *low temperature* is *a positive benefit:* and as to the erroneous notion entertained by such ignorant persons as the writers of the effusions before referred to, that atmospheric air *acidifies* the liquor, and thereby decreases the quantity of sugar, and increases the amount of molasses; the fact is, the *air* actually and very considerably *sweetens* both those articles, which my own experience has proved, and it is also certified by the testimonials, copies of which I send herewith for your perusal. Any resident of the West Indies, who may be desirous of knowing why atmospheric air produces this effect, may consult the treatise on the manufacture of sugar, which I presented to the Royal Agricultural Society of Jamaica, by whose order it was printed in the *Jamaica Times* newspaper of the 12th and 19th December, 1844.

Certainly, saccharine solutions of a low *specific gravity*, and particularly cane-juice, are acidified by exposure to the atmosphere, but the reverse is the case, as practice has demonstrated, when that influence is exerted by *forcing air into boiling syrup of double and treble the specific gravity of cane-juice.* Atmospheric air, or, at least, one of its component parts, has a chemical effect in increasing the sweetness of syrup under the influence of heat; and the like effect is produced upon raw sugar made humid by cold water and under a partial pressure of the atmosphere; which last-mentioned effect I have verified by operations upon near 10,000 tons of raw sugar. Your most obt. Servant,

H. CROSLEY.

Emerson-street, Southwark,
16th January, 1846.

[The testimonials accompanying Mr. Crosley's letters are fourteen in number, and all of a highly satisfactory character. We select two of the most remarkable.]

*Messrs. Cruikshank, Melville, and Co., of London, to Messrs. Fawcett, Preston, and Co., Liverpool.*

20th February, 1840.

We have received a letter from Mr. Crosley requesting us to transmit to you our opinion of the efficacy of his patent methods of boiling sugar. On this subject we are enabled to speak with confidence, having now before us samples of sugar made, upon Richmond Estate, St. Vincent, both by the process patented by Mr. Crosley and by the old method, in general use throughout the West Indies. That made by the patent method (steam and air) has been sold at 65s. 6d. per cwt., whereas that made by the old method has only commanded 61s. When we state to you this fact, we think farther comment on it unnecessary.

*From Messrs. N. and M. Mayo, of London, (Sugar Brokers,) to Mr. Crosley.*

Mincing-lane, Jan. 9, 1846.

We are happy in being able to testify that the effect of your new apparatus in the manufacture of sugar, on Mr. Martin's Estate, in Antigua, has been very greatly to improve its character. We would remark, that the sugar so made was of a dry and clean nature, well manufactured, and exceedingly sweet and well flavoured. Its market value was increased 4s. per cwt. Wishing you all success. We remain, &c.

## GENERAL PASLEY AND THE GAUGE QUESTION.

General Pasley complains in a letter to the *Times* that his evidence at the late Thetford inquest has been misrepresented in the newspaper reports: having given that evidence in our last Number, it is due to the General that we should give also his more correct version of it.

"My opinion on this question has always been, that the narrow gauge is too narrow, and the broad gauge much wider than was absolutely necessary; and, therefore, I recommended in March, 1843, that a gauge of 5 feet 3 inches should be established for all railways in Ireland, in preference either to the narrow gauge of the English railways (4 feet 8½ inches), adopted on the Dublin and Kingstown Railway, or to the broad gauge of the Ulster Railway (6 feet 2 inches), which, though ten inches narrower than that of the Great Western Railway, I considered wider than was absolutely necessary. My opinions on this head have not been altered since, and on being examined by Lieutenant-Colonel Sir Frederick Smith, Mr. Airy, Astronomer Royal, and Professor Barlow, the Commissioners appointed to inquire into the gauge of railways on the 18th ult., before the accident on the Norfolk Railway occurred, I stated that the extent of railway lines in England would certainly be doubled, and might probably be trebled, in the course of some years, and therefore I thought that both the present wide gauge of the Great Western Railway, and its extensions and branches, as well as the narrow gauge of the other railways in Great Britain, ought to be abolished, and the 5 feet 3 inches gauge adopted instead.

"The trials between the broad and narrow gauges made under the inspection of the Gauge Commissioners, by means of experimental passenger trains and goods trains, loaded with equal weights, had not then taken place; but previously to my being examined by the Gauge Commissioners, I had been required, in the course of my duty, to give an opinion whether the speed of the express trains then running on various railways might not be dangerous to the public safety. As I knew from long experience that the oscillation of a railway carriage was no proof of danger, and its steadiness not always a proof of safety, I therefore investigated this subject by travelling on the locomotive engines of all the

express trains in England, which affords the only just criterion of safety or of danger; and I found that not only the engines of the Great Western, but those of the narrow-gauge lines, such as the South Western, the Brighton, Grand Junction, Midland Counties, and other railway companies, whether constructed according to the designs and specifications of their own locomotive engineers, with outside or inside cylinders, or from the designs of Messrs. Sharp Brothers, Hawthorn, Fairbairn, and other skilful locomotive engine-makers, as well as the new-pattern engine of Mr. Bodmer, were all steady, especially the last, and consequently all safe; but when I tried the White Horse of Kent, one of Mr. Robert Stephenson's last patented long-boiler engines, on the 18th of September last, I found that it rolled like a ship at sea when pushed to a velocity of about 45 miles an hour between London and Tunbridge, on the South-Eastern Railway, and this uneasy motion having increased in proportion to the speed, I came to a conclusion, if an attempt were made with such engines to rival the speed of the Great Western express trains, that they would run off the rails and overset. I have expressed this opinion since to the noble president, and to my colleagues the other officers of the Railway Department of the Board of Trade, and to railway officers whom I have met with on duty, not excepting gentlemen who have been pupils of Mr. Robert Stephenson, or who are employed on railways of which he is either the engineer-in-chief or the consulting engineer. I have also stated the same opinion to enginemen in charge of locomotive engines of this construction, on which I have since travelled; but I never had occasion, as mentioned in the newspaper report, to tell these men that they were actually in danger, for they never went down descending gradients at a greater speed than about 30 miles an hour; and they never exceeded the speed of 45 miles an hour on level portions of railway, whilst I was present. Hence I did not think that the dangerous character of these engines would ever be practically proved, because both on the Eastern Counties and Norfolk Railways, where they were most used, the time between the stopping stations of the swiftest trains was so regulated, that there was no necessity for exceeding that speed excepting on the old well-consolidated portion between London and Bishop's Stortford, which I have travelled over at 45 miles an hour on an engine of the construction alluded to, but even at that speed it oscillated a great deal; when diminished, it became steady. My former opinion of Mr. Robert Stephenson's new long-boiler engines was favourable, for when I first travelled on them on the 12th of April, 1844, whilst inspecting the Yarmouth and Norwich Railway, it was at a rate not exceeding from 30 to 35 miles an hour, at which they are steady and safe; nor did I discover any objection to them on the Gravesend and Rochester Railway, where they are always used at moderate speed, until I travelled on the White Horse of Kent with a swift train of the South-Eastern Railway Company, as before mentioned.

"In my evidence before the coroner's inquest at Thetford I therefore ascribed the accident partly to the imprudence of the engineman in running down a long descending gradient of 1 in 200 at the utmost speed that his engine could command, and partly to the peculiar construction of that engine, which I considered unsafe at a speed exceeding 45 miles an hour; a speed that was perfectly unnecessary on any part of that line, but especially on that portion of it where the accident occurred, between Harling-road station and Thetford, a distance of only eight miles, for travelling over which 46 minutes were allowed.

"As I inferred, from a question put to me, that the jury had an erroneous notion, that the engine to which this accident occurred, as well as those which ran off the rails on the Eastern Counties line first near Chesterford, and afterwards near Littlebeach, were engines built for the wide gauge, and therefore unsafe for the narrow gauge, I explained to them that the width between the wheels on the narrow gauge was too small to admit of boilers of such large diameter as those of the engines of the Great Western Railway, which had greater power than any before used. Mr. Robert Stephenson tried to get over this difficulty by increasing the length of his boilers, since he could not increase their diameter beyond a certain limit, in hopes that the greater length of the boilers, and consequently of the tubes, would produce an additional evaporating surface, and render his long engines superior in power to all the former short-boiler engines of the narrow gauge, as well as to engines with boilers of larger diameter of the Great Western. In this attempt, which at the time appeared very promising, I consider that he had failed, as I stated in my evidence before the coroner's inquest; for his engines with long boilers are by no means so powerful as those of the Great Western, nor do I think that they excel in power; indeed, from my personal observation, I should say that they are inferior in power to other engines made for the narrow gauge, having boilers of moderate length, to which they are certainly much inferior in safety; for I have travelled on the engines alluded to, whether having outside or inside cylinders, at the rate of 50 miles an hour or upwards; and I am of opinion, that though certainly inferior to those of the Great Western Railway in power, they are perfectly safe at the utmost speed they are capable of attaining. Indeed, I have been informed by railway officers not personally interested in the battle of the gauges, that one of Messrs. Sharps Brothers' engines, with a light express train, travelled over the whole distance of 31 miles, between Manchester and Crewe, in 30 minutes, which must have exceeded 60 miles an hour for great part of the way. But when I rode upon the same engine afterwards, on the 23rd ultimo, from Stockport towards Crewe, whilst it was drawing a train of 47½ tons, in a stiff gale, it only accomplished 10 miles in 13 minutes and 52 seconds, which induced the narrow-gauge party not to employ it in the trial of power and speed before the Gauge Commissioners, as they had at first intended; but to transfer the scene of action to York, and to use engines of the long-boiler pattern.

"The peculiar danger in Mr. Robert Stephenson's long boiler engines, whether made with outside or inside cylinders, is, that, in consequence of their extreme length, he has placed the axles of all his wheels under the boiler, having the fire-box and dome an overhanding weight in the rear, which was never done before, except in the short four-wheeled engines of Mr. Bury's pattern, on the London and Birmingham Railway, which I do not consider by any means so good as six-wheeled engines; but in travelling upon one of them by an express train on the 6th of October last, I found it steady and safe. in consequence of the tender being screwed up close to the engine with buffers and springs, which converts the two as it were into an eight-wheeled engine. I never travelled on a four-wheeled engine at a very great speed before, but I am informed by locomotive engineers and enginemen who have, that until this improvement was adopted, they pitched and rolled like a sailing vessel in a gale of wind. Probably the same expedient may render Mr. Stephenson's long-boiler engines also much steadier and consequently safer.

"In respect to the question put to me by the coroner, whether shutting off the steam suddenly at high speed could cause the carriages to run against the engine with such violence as to knock it off the rails, I explained that a locomotive engine being considerably heavier than the tender, and at least double the weight of any of the carriages of a railway train, and the whole moving, of course, with equal velocity whilst connected, I thought that the act of suddenly shutting off the steam from the engine could not possibly cause the carriages to press upon it, because having much greater *momentum* it would retain its speed longer; and if

the connexion between the engine and tender, and the carriages of a train were cast off immediately after shutting off the steam, the engine would leave the carriages behind, and travel to a greater distance than any of them before it stopped. If shutting off the steam suddenly could have any effect, as I found by trial it had not, accidents like that near Thetford ought to occur every day; for it is a common practice with enginemen, on preparing to stop, to shut off their steam all at once; as I observed that the driver of one of Messrs. Stotherd and Slaughter's engines did, the same evening that I returned from Thetford, when I took the opportunity of travelling some stages on that engine; but this he did of his own accord, and not by my desire, as your reporter stated through mistake. The experiment, however, can easily be tried on a descending gradient. Let an engine with its tender, drawing a train of coal wagons, be set in motion. I am ready to go with Mr. Bidder on any of the narrow gauge engines, except those of the long-boiler pattern, at full speed, down an incline, and to shut off the steam suddenly, and to cast off the train immediately afterwards by disengaging a pin, as is done by the auxiliary engines of heavy down-trains of the London and Birmingham Railway Company, near their Camden-town station, several times every day, and I will prove to him that the effect is null. Should he have doubts as to the safety of the experiment, he may ride in a carriage in the rear, whilst I stand on the engine, in as much confidence of the safety of my position as he can have of his own. But I shall not argue the point with him in writing. He has given his opinion and I have given mine; and his time may be better employed than in paper warfare, which can prove nothing.

"Having always had occasion to approve of the railway works actually designed and executed by Mr. Bidder, though nominally under Mr. R. Stephenson, as engineer-in-chief, in which he has displayed equal skill and judgment, and especially in his iron swing-bridge over the river Wensum, near Norwich, which does him very great credit, it was a matter of regret to me, that I could not conscientiously do otherwise than entirely dissent from Mr. Bidder's opinion in respect to the cause of the accident on the Norfolk railway.

"Having now explained my evidence in a clearer manner than was done in the report made in the morning papers of the 14th inst., before alluded to, I must notice some errors as to fact in that report; after having corrected which, the remainder of it will be quite accurate. In the first place, I did not say that the flanges of Messrs. Stotherd and Slaughter's engines were deficient in depth; on the contrary, they had the usual depth of 1½ inch, which I stated as being quite sufficient; but they were set nearly at right angles to the tread of the wheel, contrary to the rule followed in all other locomotive engines that I have seen, which is to round off that angle nearly in the form of a quadrant. Though similar to Mr. Robert Stephenson's last pattern in other respects, the fire-box did not project entirely in the rear as a dead weight, but had its centre placed over the axle of the hind wheels, which rendered it necessary to raise the top of the boiler about nine inches higher, and consequently, though better balanced on their wheels, they had the disadvantage of being more top-heavy than Mr. Stephenson's pattern. The present locomotive engineer of the Eastern Counties Railway assured me that they had not only been all provided with new wheels of the usual form, but that they were much improved since two of them ran off the rails and overset, the first with excessive speed down an incline and along a curve, which terminated fatally; the second on a level and straight portion of the line, and at very moderate speed, so that no person was injured. If these engines had been an exact copy of Mr. Stephenson's pattern, the last-mentioned accident would not have taken place.

"In mentioning the gauge commissioners, there were also several inaccuracies in your reporter's account of my evidence, in consequence of which I was obliged to write to them to explain, lest they should consider me wanting in courtesy towards them. In the first place, being independent of the Board of Trade, they gave no opinion, as implied in the newspaper account, and sent no report to the board, of the accident that occurred to an experimental train on the Great North of England Railway, on the 1st inst., by a long-boiler engine running off the rails and being overset; for though they afterwards inquired into it at York, in presence, I presume, of Mr. Close, secretary of that company, the depositions of the evidences who came before them on that occasion were transmitted officially by that gentleman, together with a report of the accident, as required by act of Parliament. On inspecting the engine itself, at Derby, last week, I found that instead of being an exact copy of Mr. Robert Stephenson's long-boiler pattern I had supposed at the period of the inquest, it differed from it in two points; first, in having been made with inside cylinders, in order to do away the oscillation generally, but I think erroneously, ascribed to outside cylinders; and, secondly, in having an oval boiler, in order to obtain greater sectional area than the narrow gauge admits of, when the cylindrical form is used. Neither of these alterations can be considered an improvement, as they both produced the unfavourable effect of rendering it necessary to raise the boiler higher than in Mr. Stephenson's pattern. It was also erroneously stated by your reporter, that the gauge commissioners were in a train from Bristol to Gloucester, upon the engine of which I travelled with Mr. M'Connel, locomotive superintendent of the Bristol and Birmingham Railway, erroneously styled Mr. Connel, when I first tried the experiment of shutting off the steam in going at full speed. Moreover, when I tried the same experiment a second time, by permission of Mr. Brunel, on the engine of an experimental goods' train, on the Great Western Railway, in which the commissioners were travelling from Paddington to Didcot, it had a load of 205 tons only, instead of 2,000 tons, as stated in the newspaper report.

"I shall here observe, though it made no part of my evidence before the coroner's inquest at Thetford, with which the question of the gauges had very little to do, that I have drawn an inference from the performance of the experimental trains of both; namely, *that the narrow gauge has failed in the most important points of railway travelling, as it has not room between the wheels for a boiler of sufficient power to obtain that speed, combined with safety, which the travelling public have a right to expect*, and which the express trains of the Great Western Railway Company have proved to be perfectly practicable. This is another argument for abolishing the narrow gauge, and adopting 5 feet 3 inches, as the standard gauge of all our railways, as that will admit of a boiler of more than four feet in diameter, which is the *maximum* dimension hitherto adopted for the engines of the Great Western Railway."

## STEAM STATISTICS OF BENGAL.

The *Friend of India* has published an elaborate article on the steam statistics of the Bengal Presidency. It appears that there are 15 engines working at the rate of 168-horses power, in sugar factories; 14 engines with 123-horses power, in sugar refineries; 8 engines with 111-horses power, employed in the traffic of the docks; 8 engines, with 80-horses power, in the collieries; 6 engines, with 150-horses power, in the

flour and rice mills; 4 engines, with 46-horses power, in the paper manufactories; and 15 engines, with 238-horses power, in miscellaneous establishments. The steamers carrying on the trade of the Presidency, including the *Hindostan*, *Bentinck*, and *Precursor*, number 73 engines, with 4,894-horses power. In the Government departments 8 engines, with 168-horses power, were employed. The steamers building would increase the number of engines by eight, with 370-horses power; and the sugar factories in progress would further augment the amount by 4 engines, with 70-horses power. The summary of this statement is as follows:—

| | Engines. | Horse-power. |
|---|---|---|
| Sugar works and refineries.. | 29 | 291 |
| Docks..... | 8 | 111 |
| Collieries..... | 8 | 80 |
| Flour and rice-mills ..... | 6 | 158 |
| Paper manufactories ..... | 4 | 46 |
| Miscellaneous..... | 15 | 238 |
| Government departments .. | 8 | 168 |
| Sea-steamers ..... | 20 | 1,030 |
| Inland steamers ..... | 22 | 770 |
| Packets..... | 10 | 1,980 |
| Tugs and pleasure boats .. | 21 | 1,114 |

From this account it seems that there are in active employment in the Bengal Presidency no fewer than 151 steam engines, of nearly 6,000 horses power. It is generally supposed that the first steam-engine set to work in the Presidency was introduced by the Serampore missionaries in the year 1820, for the manufacture of paper, which then sold at 150 per cent. beyond the price now realized in the market. Before that event, it is said a Mr. W. Smith employed a small engine of two-horses power in his dockyards, but the statement is regarded as not altogether authentic. Between the years 1820 and 1837, 65 engines, of 1,800 horses power, were introduced, 35 engines, of 574 horses power, being contributed by the enterprise of private individuals, and 30 engines, of 1,258 horses power, by the Government. It is, however, during the last seven years, since the liberty granted to Europeans to hold lands in India has effectually come into operation, that the extraordinary increase of steam power, as applied to agricultural improvements, has taken place. During this period the number of steam-engines introduced into the country by private individuals and public associations, as well as by the Government, amounted to 97, and the aggregate horse-power to 4,700. Neither has the increase of steam machinery reached its height. The introduction of new engines continues without diminution. Every year, and almost every month, new factories are established, and attempts are constantly in progress to apply steam power to fresh branches of labour. It is considered that the Presidency of Bengal is only in its infancy as regards the employment of steam power, and the statistics of another seven years, it is believed, will create much greater surprise than those now published. It is further stated, that the quantity of coal brought down from the Burdwan colleries during the present season had amounted to 72,000 tons, or about 20 lacs of maunds; and such was the rapid increase of steam-engines, that even this supply was by no means adequate to the demand. Besides this, the numerous sugar works were rapidly consuming the available supply of wood, so that, according to the *Friend of India*, the continuance of manufactures in the Agra presidency will soon depend on the chance of obtaining coal from the lower provinces by means of the rail.

## SINGULAR CASE OF EXPLOSION.

Sir,—An occurrence took place to me to day which appeared rather mysterious, but on which, perhaps, some of your readers may be able to throw some light. I was having some pipes fitted up for gas, which had previously been used for the conveyance of oil-gas, and after one of the pipes had been straightened, I blew through it, and all was perfectly clear; I then wished to have that piece of pipe turned at right angles, which was done while I was in the workshop; I then blew through it again to see that it was clear, but found an obstruction. The person who had turned it, then passed a long gimlet through it to clear it, and found the obstruction about six inches from the angle; he gave the gimlet a turn, and immediately an explosion took place, about equal to an ordinary gun, driving his hand and the gimlet backwards, and the pipe at the other end, which was open, discharging a light and a quantity of black dust, which produced a smoke and effluvia which rendered the shop for some time unbearable. I believe there was an occurrence of this kind took place at New York, about six years ago, which cost a man his life.

The way I account for it myself is, that the oil-gas in passing through a copper tube —for it was a copper tube that the accident took place in—decomposes, in a degree, the metal, and forms a kind of detonating powder which, when friction is applied to it, will, as we all know, explode. But I may be wrong, and if any of your readers can favour me with a more correct statement of the cause, I shall be greatly obliged.

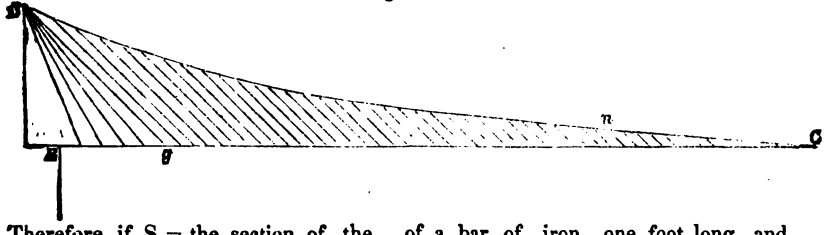
I am, Sir, your constant reader,
FRANCIS ARDING.

Taunton, January 21st, 1840.

SUSPENSION BRIDGES.—INVESTIGATION OF THE TENSION IN THE CHAINS OF BOTH THE NEW AND OLD SYSTEMS, SHOWING BY COMPARISON WITH NUMERICAL CALCULATION THE SUPERIORITY, BOTH AS REGARDS ECONOMY AND SAFETY, OF THE FORMER OVER THE LATTER. BY JAMES DREDGE, ESQ., BATH.

By referring to fig. 1, it will be seen that a part of the platform is supported by several oblique bars, which proceed direct from the tops of the towers; of necessity therefore, the weight that these bars sustain cannot affect the chains beyond the point of suspension; and therefore in estimating the tension in the chains at these points, the weight of the segment of the roadway only that is beyond the influence of the direct suspending bars from the towers, together with the action of the weight of the chain, have to be considered.

Fig. 1.




Therefore, if S = the section of the iron in inches, of the chains at the base B, Z = the length of the semicurve B C in feet, $l$ = the segment of the platform $g$ C also in feet, $\mu$ = the weight of each lineal foot of platform, $\mu_2$ = the weight of a bar of iron, one foot long, and one inch square, and $\phi$ = the angle of suspension, that is, the angle which the first link in the chains would, if continued, make with the horizontal line; then

$$\text{Tension in the chains at the point of suspension} = \frac{\mu l + \frac{\mu_2 S Z}{2}}{\sin.\ \phi} \quad . \ . \ . \ (A)$$

*Example* 1. Let the weight of the segment of the platform that is beyond the influence of the direct suspending bars from the towers be equal to 255·68 tons, and the weight of the semicurve 18 65 tons, what is the tension at the point of suspension?*

$$\mu l + \frac{\mu_2 S Z}{2} = \frac{255{\cdot}68 + 18{\cdot}65}{\sin.\ \phi} = \frac{274{\cdot}33}{\sin.\ \phi} \text{ tons.}$$

This involves the sin. of the angle of suspension, which we will proceed to obtain.

If, in a system of forces in equilibrium, the direction of any two be extended until they intersect each other, and the weight these two collectively support be placed at the point of intersection, the equilibrium of the aforesaid forces will not be affected by it, and the point of intersection must be vertically situated with respect to the centre of gravity of the weight so supported. Hence, if the direction of the first link of the chain be continued, it would intersect the roadway in a point which would be situate in a vertical line with respect to the centre of gravity of $\mu l + \frac{\mu_2 S Z}{2}$. Very intricate analytic investigation is necessary to determine the exact position of this point, but an approximate formula for practice may be readily obtained. Since the chains decrease regularly from the base to the centre, and the variation in length of the oblique bars causes a variation of weight in them in nearly the same proportion, the centre of gravity of the chain, (at least near enough for practice) is one-third of the length from the point of suspension, and may be considered as a dead weight upon the plat-

* In the above and following examples the span of the bridge is taken at 500 feet deflection of the chain, 41·82 feet width of platform, 20 feet weight of load and platform, 140 lbs. per square foot $\mu = \frac{140 \times 20}{2240} = 1{\cdot}25$ ton. Length of chains 508 feet. $Z = 254$ feet. Value of $\mu_2 = {\cdot}0015$ ton. $l = 500 - \frac{45{\cdot}45}{2} = 204{\cdot}55$, S = 97·9 sq. in. $\mu l = 255{\cdot}68$ tons, and $\frac{\mu_2 S Z}{2} = 18{\cdot}65$ tons.

form of $\frac{\mu_2 S Z}{2}$ at the distance $= \frac{L}{3}$ from the abutment E.

The platform itself is a parallel weight, and its centre of gravity must be situated in a point measured halfway along its length; but as only the portion $Cg = l$ is suspended to the chains, the distance of the centre of gravity of the segment of the platform from the abutment E must be $= \frac{1}{2}l + E g = L - \frac{1}{2}l$, if L = E C. Then to find the centre of gravity of the weights $\mu l$, and $\frac{\mu_2 S Z}{2}$ concentrated at the distances $L - \frac{1}{2}l$, and $\frac{L}{3}$ from the abutment E, put $g$ equal this distance; then by a well-known theorem in the doctrine of statics,

$$g = \frac{\mu l \left(L - \frac{1}{2}l\right) + \frac{\mu_2 S Z}{2} \cdot \frac{L}{3}}{\mu l + \frac{\mu_2 S Z}{2}} \quad . \quad . \quad . \quad (B.)$$

*Example* 2. Let the weight, &c., of the platform remain as in the last example, then the centre of gravity of the segment of the platform $l$, is 147·73 feet distant from the abutment, and one-third of the semichord will be 83·33 feet, and consequently the centre of gravity of the whole is

$$g = \frac{255{\cdot}68 \times 147{\cdot}73 + 18{\cdot}65 \times 83{\cdot}33}{255{\cdot}68 + 18{\cdot}65} = 143{\cdot}4 \text{ feet.}$$

The quantity just enunciated is equal to cotangent of the angle of suspension, the height of the towers, or deflection of the chains, being considered as radius. Therefore, if $r$ be put for the height of the towers

$$\text{cot. } \phi = \frac{g}{r} \quad . \quad . \quad . \quad (C.)$$

from which $\phi$ may be found on referring to a table of sines.

*Example* 3. The distance of the centre of gravity, as found by the last example, is 143 4 feet, and as the towers are assumed 41·82 feet high, we have by equation (C)

$$\text{Cot. } \phi = \frac{143{\cdot}4}{41{\cdot}82} = 3{\cdot}431 = \text{cot. } 16^\circ\ 15'.$$

Therefore,

$$\phi = 16^\circ\ 15'$$

Now sin. 16° 15′ = ·27983, and consequently, by bringing down example 1, we shall have the numerical value of the tension at the point of suspension

$$\frac{274{\cdot}33}{{\cdot}27983} = 980{\cdot}3 \text{ tons.}$$

It has also been shown by writers on the subject that the tensions in the chains of a suspension bridge may be considered in the light of the hypothenuses of right-angled triangles, whose other sides are respectively represented by the horizontal force and weight, therefore,

Tension at B $= \left\{p^2 + w^2\right\}^{\frac{1}{2}}$, where $w = \mu l + \frac{\mu_2 S Z}{2}$, and $p = \frac{g}{w r} = \left(\mu l + \frac{\mu_2 S Z}{2}\right) \frac{\mu l \left(L - \frac{1}{2}l\right) + \frac{\mu_2 S Z}{2} \cdot \frac{L}{3}}{r \left(\mu l + \frac{\mu_2 S Z}{2}\right)}$ substituting those values of $p$ and $w$, and reducing,

$$\text{Tension at B} = \left(\mu l + \frac{\mu_2 S Z}{2}\right) \left\{ \left( \frac{\mu l \left(L - \frac{1}{2}l\right) + \frac{\mu_2 S Z}{2} \cdot \frac{L}{3}}{r \left(\mu l + \frac{\mu_2 S Z}{2}\right)} \right) + 1 \right\}^{\frac{1}{2}} \quad . \quad . \quad . \quad (D.)$$

which may be reduced to a numerical example, as follows.

*Example* 4. The cotangent of $\phi$ has been found to equal 3·431 (rad. = 1,) and the whole of the suspended weight = 274·33 tons, consequently the tension at the points of suspension is

$$274{\cdot}33(3{\cdot}431^2 + 1)^{\frac{1}{2}} = 980{\cdot}3 \text{ tons.}$$

*Note.* Equation (D) is evidently deducible from equation (B), for $\frac{1}{\sin.} = \text{cosec.} = \sqrt{\text{cot.}^2 + 1}$, which is the same as above.

From equation (A) the requisite section of iron at the base of the chains may be determined: put $m$ = the tensile strength per square inch, and suppose it

equal to $q$ times the strain to which it will be subjected, then

$$\frac{m\,S}{q} = \text{tension at B} = \frac{\mu l + \frac{\mu_2 S Z}{2}}{\sin.\ \phi}$$

*Example* 5. Let the tensile power of a bar of iron be equal to 27 tons, and suppose this 2·7 times the tension to which it is intended that it should ever be exposed, everything remaining the same as in the previous examples, we shall have

Solving this equation with respect to

$$S = \frac{q\mu l + \quad}{m \sin.\ \phi - q\frac{\mu_2 Z}{2}} \quad . \ . \ . \quad \text{(E.)}$$

$$S = \frac{255{\cdot}68 \times 2{\cdot}7}{30 \times {\cdot}27983 - \frac{{\cdot}0015 \times 254 \times 2{\cdot}7}{2}} = 97{\cdot}97 \text{ inches};$$

consequently the sectional area of the chains at the base should be 97·97 square inches.

It has been shown, equation (D), that tension $= \{p^2 + w^2\}^{\frac{1}{2}}$, which equation, by substituting the proper values of $p$ and $w$ is applicable to every part of the curve. Let it be applied to any point in the chain $n$.

Now $p$, which represents the horizontal force has three component quantities.

1. The tension in the central link.*
2. The horizontal pressure caused by the action of the oblique suspending bars supporting the platform.
3. The horizontal action of the chain.

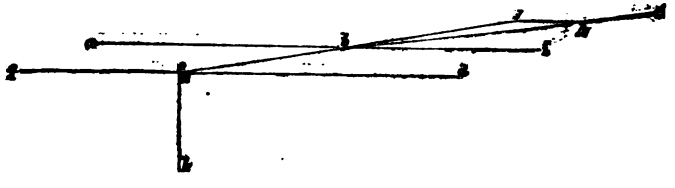
The sum of these several quantities, when $n$ coincides with B, we have already seen is

$$= \left(\mu l + \frac{\mu_2 S Z}{2}\right) \frac{\mu l\,(L - \frac{1}{2}l) + \frac{\mu_2 S Z}{2} \cdot \frac{L}{3}}{r\left(\mu l + \frac{\mu_2 S Z}{2}\right)}$$

but when it refers to a point situated anywhere between B and C, the quantities must be separately estimated.

1. The tension on the central link. Let $a\,b$ be the central link of the chain, $b\,c$ the next link towards the towers, $b\,e$ an oblique rod next the centre, and $f\,d$ the segment of the platform supported by this bar. Now the point $b$ is maintained in equilibrium by the joint action of three forces pressing in the directions $ba$, $bc$, $be$. Extend $eb$ to $g$, and from $g$ draw $gh$ parallel to $ab$, then will $bgh$ be the triangle of equilibrium of the forces at the point $b$. $b\,g$ will represent the tension in the oblique bar, $gh$ the tension in the central link, and $hb$ the tension in the link $b\,c$. Now the angle $g\,b\,h =$

Fig. 2.



* There is no absolute necessity for a central link, but as in practice I usually employ one, I put a tension in it. That this may be what the engineer pleases is shown by an examination of its equation, in which,

$$\text{Tension on central link} = \frac{\mu\delta \sin.\ (a_1 - \phi_0)}{\sin.\ a_1 \sin.\ \phi_0}$$

when it becomes a tangent to the curve at the point $b$, $\phi_0 = a_1$, and

$$\text{Tension on central link} = \frac{\mu\delta \sin.(a_1 - \phi_0)}{\sin.\ a_1 \sin.\ \phi_0} = 0$$

from which it appears that this equation depends entirely on the magnitude of the angles in the neighbourhood, and as these angles are under the control of the engineer, the truth of the observation is manifest.

$g\,b\,i - h\,b\,i = g\,e\,d - h\,b\,i$, and angle $g\,h\,b = h\,b\,i$, substituting therefore these values for the angles $g\,b\,h$ and $g\,h\,b$, and reducing by a well-known theorem in plane trigonometry,

$$gh = \frac{gb \text{ sin. } (ged - hbi)}{\text{sin. } hbi.}$$

But $g\,h$ represents the tension in the central link, and $g\,b$ the tension in oblique bar $eb$; therefore

$$\text{Tension in central link} = \frac{\text{Tension in } eb \text{ sin. } (ged - hbi)}{\text{sin. } hbi.}$$

Put $a_1 = ged$, $\phi_0 = hbi$, then tension in $eb = \frac{\mu\delta}{\text{sin. } a_1}$; so by substituting these values the equation of equilibrium becomes

$$\text{Tension in central link} = \frac{\mu\delta \text{ sin. } (a_1 - \phi_1)}{\text{sin. } a_1 \text{ sin. } \phi_0}$$

2. The horizontal pressure from the oblique bars. It is easily shown that if that $e$ is a point in equilibrium also maintained by the action of the three forces, $\mu\delta$ cose. $a_1$ in the direction $eb$, $\mu\delta$ in the direction $ek$, and the pressure in the direction $ed$, which being reduced to the form of an equation on the principle of the parallelogram or pressures, becomes,

the tension in $eb = \frac{\mu\delta}{\text{sin. } a_1} = \mu\delta$ cose. $a_1$

that the pressure in the direction $ed = \mu\delta$ cot. $a_1$. For let it be observed

$$\text{Pressure in } ed = \left\{(\mu\delta \text{ cose. } a)^2 + (\mu\delta)^2 - 2\mu\delta \text{ cose. } a_1\ \mu\delta \text{ sin. } a_1\right\}^{\frac{1}{2}}$$

but cose. sin. = 1, so by reduction,

$$\text{Pressure in } ed = \mu\delta\left\{\text{cose.}^2 a_1 + 1 - 2\right\}^{\frac{1}{2}} = \mu\delta\left\{\text{cose.}^2 a_1 - 1\right\}^{\frac{1}{2}} = \mu\delta \text{ cot. } a_1$$

But as between any point $n$ in the chain, and the centre, there are $n-1$ oblique bars, making angles with the horizon, that are expressed by the symbols $a_1\ a_2\ a_3$, &c. $-a_{n-1}$. The amount of horizontal pressure equal to the sum of these is expressed by the formula.

$$\mu\delta\left\{\text{cot. } a_1 + \text{cot. } a_2 + \text{\&c. . . . cot. } a_{n-1}\right\}$$

3. The horizontal action of the chains. This is here only an approximation, and is expressed by the formula

$${}_2\,\delta_1\left\{2 \text{ cot. } a_1 + 3 \text{ cot. } a_2 + \text{ \&c. . . . } n \text{ cot. } a_{n-1}\right\}$$

Where $\delta_1$ = the length of link, $\tau$ = its section, and 2, 3, &c. $- n$, the numbers of links at points in the chain corresponding with the angles $a_1\ a_2$ &c. $-a_{n-1}$

Collecting these several quantities the value of $p$ becomes

$$p = \left\{\frac{\mu\delta \text{ sin. } (a_1 - \phi_0)}{\text{sin. } a_1 \text{ sin. } \phi_0} + \mu\delta\ (\text{cot. } a_1 + \text{cot. } a_2 + \text{\&c. . . . cot. } a_{n-1}) + \right.$$

$$\left. \mu_2\delta_1\tau(2 \text{ cot. } a_1 + 3 \text{ cot. } a_2 + \text{\&c. . . . } n \text{ cot. } a_{n-1})\right\}$$

$w$ may be referred to two parts;* first, the parallel weight of the roadway, which is represented by $(n-1)\ \mu\delta$, and secondly, by the variable chain, the weight of which between any point $n$ and the centre is expressed by $\frac{n(n+1)}{2}\mu_2\delta_1\tau$,

* When $n$ coincides with B $(n-1)\ \delta = l$, and $\frac{n\ (n+1)}{2}\ \tau\ \delta_1 = \frac{\text{S Z}}{2}$, so that $w = (n-1)\,\mu\,\delta + \frac{n(n+1)}{2}\,\mu_2\delta_1\,\tau$ becomes $= \mu l + \frac{\mu_2\ \text{S Z}}{2}$ as shown in a previous equation.

then $w = \left\{(n-1)\,\mu\delta + \frac{n(n+1)}{2}\mu_2\delta_1\tau\right\} -$ ; so that,

Tension in the chains at $n = \left\{p^2 + w^2\right\}^{\frac{1}{2}} =$

$$\left\{\left(\frac{\mu\delta \text{ sin. } (a_1 - \phi_0)}{\text{sin. } a_1 \text{ sin. } \phi_0} + \mu\delta(\text{cot. } a_1 + \text{cot. } a_2 + \&c \ . \ . \ \text{cot. } a_{n-1}) + \right.$$

$$\left.\mu_2\delta_1\tau(2 \text{ cot. } a_1 + \text{cot. } a_2 + \&c. \ . \ . \ . \ n \text{ cot. } a_{n-1})\right)^2 + \left((n-1)\mu\delta + n\frac{(n+1)}{2}\mu_2\tau\delta_1\right)^2\Big\}^{\frac{1}{2}} \ . \ . \ (F)$$

*Example* 6. Let there be eight oblique bars attached to the segment of the curve between the point $n$ and the centre of the bridge, whose angles with the horizon, are 9° 30′, 11° 30′, 13°, 14° 35′, 15° 55′, 17° 45′, 18° 25′, and 19° 35′. The distance between the points at which they are attached on the road from each other is 6 feet, (the section of iron in the chains at the points of suspension has been shown to be 97·97 inches, which has 204·55 lineal feet of platform to support: now $\frac{204{\cdot}55}{6} = 34$ nearly), consequently there are 34 links at the points of suspension, each equal to $\frac{97{\cdot}97}{34} = 2{\cdot}88$ inches, and since there are nine links to sustain the eight oblique bars, we have $2{\cdot}88 \times 9 = 25{\cdot}92$ ins. of section at the point $n$. Let 7·38 feet be the length of each link, and the direction of the last link (next the central) be 7° from the horizon, and the rest of the data remain as before.

$$\mu\delta = \frac{140 \times 20 \times 6}{2240} = 7{\cdot}5 \text{ tons},$$

$$\text{sin. } (a_1 - \phi_0) = \text{sin. } (9° 30' - 7°) = \text{sin. } 2° 30' = {\cdot}04362.$$

$$\text{sin. } a_1 \text{ sin. } \phi_0 = \text{sin. } 9° 30' \times \text{sin. } 7° = {\cdot}165 \times {\cdot}1218 = {\cdot}0201.$$

$$\frac{\mu\delta \text{ sin. } (a_1 - \phi_0)}{\text{sin. } a_1 \text{ sin. } \phi_0} = \frac{7{\cdot}5 \times {\cdot}04362}{{\cdot}0201} = 16{\cdot}275.$$

Next,

| | | | |
|---|---|---|---|
| Cot. 9° 30′ | = 5·076 | 2 Cot. 9° 30′ | = 11·952 |
| Cot. 11° 30′ | = 4·915 | 3 Cot. 11° 30′ | = 14·745 |
| Cot. 13° | = 4·331 | 4 Cot. 13° | = 17·324 |
| Cot. 14° 35′ | = 3·844 | 5 Cot. 14° 35′ | = 19·220 |
| Cot. 15° 55′ | = 3·501 | 6 Cot. 15° 55′ | = 21·006 |
| Cot. 17° 45′ | = 3·254 | 7 Cot. 17° 45′ | = 22·778 |
| Cot. 18° 25′ | = 2·974 | 8 Cot. 18° 25′ | = 23·792 |
| Cot. 19° 35′ | = 2·864 | 9 Cot. 19° 35′ | = 25·776 |
| | 31·659 | | 156·593 |

$\mu_2\delta_1\tau = {\cdot}0015 \times 7{\cdot}38 \times 2{\cdot}87 = {\cdot}0318$ ton nearly.

$\mu\delta(n-1) = 7{\cdot}5 \times 8 = {\cdot}60$ tons.

$\frac{n(n+1)}{2}\mu_2\delta_1\tau = \frac{9 \times 10}{2} \times {\cdot}0015 \times 7{\cdot}38 \times 2{\cdot}87 = 1{\cdot}429.$ Summing the several quantities together.

*Tension at* $n = \left\{(16{\cdot}275 + 31{\cdot}659 \times 7{\cdot}5 + 156{\cdot}593 \times {\cdot}0318)^2 + (60 + 1{\cdot}429)^2\right\}^{\frac{1}{2}}$

$= 265{\cdot}9$ tons nearly.

*Example* 7. Let the point at which the tension is to be examined be the centre, then $n - 1 = 0$, $\mu\delta$ (cot. $a_1$ &c. + cot. $a_{n-1}$) = 0 ; $\mu\delta(n-1) = 0$, and $\mu_2\delta_1\tau$ (2 cot. $a_1$ + &c. − $n$ cot. $a_{n-1}$) = 0. $\frac{n(n+1)}{2}\mu_2\delta_1\tau = {\cdot}0318$ tons ; so that the example becomes,

*Tension at the centre* $= \left\{\left(\frac{\mu\delta \text{ sin. } (a_1 - \phi_0)}{\text{sin. } a_1 \text{ sin. } \phi_1}\right)^2 + (\mu_2\delta_1\tau)^2\right\}^{\frac{1}{2}} = \left\{16{\cdot}275^2 + {\cdot}0318^2\right\}^{\frac{1}{2}}$ ;

but since ·0318 is too small practically to affect the result, we may, without sensible error omit it, when *tension at the centre* = 16·275 tons.

But I have said there need not be any tension at all at the centre. Let us see, if this is not true. The formula expressing the tension is $= \frac{\mu \delta \text{ sin. } (a_1 - \phi_0)}{\text{sin. } a_1 \text{ sin. } \phi_0}$.

Now, suppose we so arrange the oblique bars that the last makes an angle with the horizon of 7°, or $a_1 = 7°$, then tension at the centre is

$$\frac{\mu \delta \text{ sin. } (a_1 - \phi_0)}{\text{sin. } a_1 \text{ sin. } \phi} = \frac{7{\cdot}5 \text{ sin. } (7° - 7°)}{\text{sin. } 7° \times \text{sin. } 7°} = \frac{7{\cdot}5 \times 0}{{\cdot}0141869} = 0.$$

Let us now pause to examine the tension at similar parts of the curve of the *old suspension bridge*.

Let $q^2 = 4Ax$ be the equation to the curve, which it is very nearly, for in practice, the chain, when the roadway is attached approximates a parabola more closely than it does a catenary.

At the points of suspension the co-ordinates of the curve are L and $r$, thus the equation becomes,

$$L^2 = 4Ar; \text{ or } A = \frac{L^2}{4r}.$$

*Note.*—In the following equations the analytic symbols refer to the same parts, and represent the same numerical values they did in the previous cases.

Example 8. L = 250, and $r$ = 41·82.

$$A = \frac{250^2}{4 \times 41{\cdot}82} = 373{,}62 \text{ feet.}$$

The sine of the angle, which a tangent to a curve makes with the ordinate at the point of contact, is

$$= \frac{\frac{dx}{dy}}{\sqrt{1 + \frac{dx^2}{dy^2}}} \text{ in the parabola } \frac{dx}{dy} = \frac{y}{2A};$$

whence by substitution and reduction sin of angle $= \frac{x}{\sqrt{\frac{y^2}{4} + x^2}}$ substituting this for sin $\phi$, and proceeding as in equation (E,) observing that in this case the chain is the same size throughout, and that its weight is expressed by $S Z \mu_2$ instead of $\frac{S Z \mu_2}{2}$

$$S = \frac{q \mu y}{m \frac{x}{\sqrt{\frac{1}{4}y^2 + x^2}} - z \mu_2 q}$$

But $\frac{Sm}{q}$ = the tension; consequently

$$\frac{Sm}{q} = \frac{m \mu y}{\frac{m x}{\sqrt{\frac{1}{4}y^2 + x^2}} - z \mu_2 q} \quad \ldots\ldots\ldots \text{(G)}$$

which is a general equation expressing the tension in the chains.

Example 9. Let it be applied at the points of suspension where,

$$y = L = 250. \quad x = r = 41{\cdot}82. \quad z = Z = 254.$$

$$\text{Tension at the point of suspension.} \left\{ = \frac{30 \times 1{\cdot}25 \times 250}{\frac{30 \times 41{\cdot}82}{\sqrt{\frac{250^2}{4} + 41{\cdot}82^2}} - 254 \times {\cdot}0015 \times 2{\cdot}7} = 1105{\cdot}34 \text{ tons.} \right.$$

Let the point be $n$, at which the co-ordinates $x$ and $y$ are not known. Let $z$ be known, then

$$z = \sqrt{y^2 + \frac{4}{3}x^2} = \sqrt{y^2 + \frac{y^4}{12A^2}};$$

solving this equation with respect to $y$, and reducing

$$y = \sqrt{6A^2 \left\{ \sqrt{\frac{z^2}{3A^2} + 1} - 1 \right\}} \quad \ldots\ldots\ldots \text{(H.)}$$

---

* This is only an approximate value of $z$,—correctly it should be

$$z = \sqrt{x^2 + Ax} + \frac{A}{2} \text{ hyp. log.} \left( \frac{2x + A + 2\sqrt{x^2 + Ax}}{A} \right);$$

but it would in this form be useless in the above investigation. That it is a new approximation appears from the following :—(*For which see foot of next page.*)

L. Example 10.—Let $z = 8{\cdot}5 \times 7{\cdot}38 + 7{\cdot}27 = 70\dagger$, when $s$ will coincide with the point $s$, before determined in the tapered chain, then

$$y = \left\{ 6 \times 373{\cdot}62^2 \left( \left( \frac{70^2}{3 \times 373{\cdot}60^2} + 1 \right)^{\frac{1}{2}} - 1 \right) \right\}^{\frac{1}{2}} = \left\{ 837550 \times {\cdot}0058 \right\}^{\frac{1}{2}} = 69{\cdot}69 \text{ feet.}$$

and since $x = \frac{y^2}{4A}$. $x = \frac{69{\cdot}69^2}{4 \times 373{\cdot}62} = 3{\cdot}25$ feet. So by substituting these values of $x$ and $y$, we get

$$\text{Tension at } s = \frac{30 \times 1{\cdot}25 \times 69{\cdot}69}{\frac{30 \times 3{\cdot}25}{\sqrt{\frac{69{\cdot}69^2}{4} + 3{\cdot}25^2}} - 70 \times {\cdot}0015 \times 2{\cdot}7} = 1044{\cdot}16 \text{ tons.}$$

and, lastly, since $\frac{dy}{dx} = \frac{\sqrt{A}}{\sqrt{x}} = \frac{y}{2x}$. Cotangent of angle of suspension $= \frac{L}{2r}$.

So that the tension on the centre link becomes

$$\text{Tension on central link} = \frac{m \mu L}{\frac{L}{-Z \mu_2 q}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(I.)}$$

Example 11.

$$\text{Tension on central link} = \frac{30 \times 1{\cdot}25 \times 250}{\frac{2 \times 30 \times 41{\cdot}82}{250} - 254 \times {\cdot}0015 \times 2{\cdot}7} = 1041{\cdot}3 \text{ tons.}$$

Now, let us put in juxtaposition the results just obtained to assist the reader in drawing his conclusion from the foregoing calculations.

| Points in the chain to which the calculations refer. | Tensions. | | Difference of tension at the several points between old and new plans. | Necessary sections of Iron. | | Remarks. |
|---|---|---|---|---|---|---|
| | Old Plan with a vertical bar and parallel chain. | New Plan, oblique bars, and tapered chains. | | Old Plan. | New Plan. | |
| | *Tons.* | *Tons.* | *Tons.* | *sq. ins.* | *sq. ins.* | By referring to the calculations, it will be seen that the taper chain varies in nearly the proportion shown in last column. |
| Base B | 1105·34 | 980·3 | 125·04 | 110·5 | 98·0 | |
| Point s | 1044·16 | 265·9 | 778·26 | 104·4 | 26·59 | |
| Centre | 1041·3 | 16·275 | 1025·025 | 104·13 | 1·6 | |

*Observations.* Column 5 shows a variation in the required section of only 6·37 ins. on 110·5 ins., or about 5·8 per cent., which is impracticable to adopt. Column 6 shows a variation in the required section of 96·4 ins. on 98, or 83·68 per cent., and which is very practicable.

Both bridges, in the above comparison,

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Expands $\left\{ y^2 + \frac{y^4}{12A^2} \right\}^{\frac{1}{2}}$ — when $z = y\left(1 + \frac{y^2}{24A^2} - \frac{y^4}{1152A^4} + \&c.\right)$; but

$$\frac{dz}{dy} = \sqrt{1 + \frac{dx^2}{dy^2}} = \sqrt{1^2 + \frac{y^2}{4A^2}} = \left(1 + \frac{y^2}{8A^2} - \frac{y^4}{128A^4} + \&c.\right); \text{ therefore,}$$

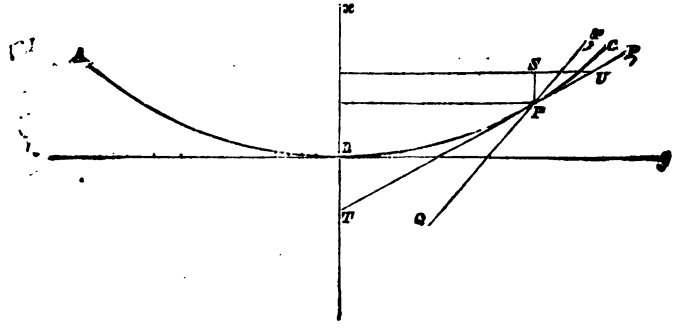
$$z = \int y \left(1 + \frac{y^2}{8A^2} + \frac{y^4}{128A^4} + \&c.\right) = y\left\{1 + \frac{y^2}{24A^2} - \frac{y^4}{640A^4} + \&c.\right\} \text{ which shows the equation (H) to be a close approximation.}$$

† 7·27 = half the central link.

are loaded exactly the same, with 140 lbs. per square foot, the dimensions of both are similar; for the same symbols have the same numerical value in both. The great advantage which the calculations show, in favour of the new plan, arises entirely in consequence of the action of the oblique suspending bar; that this is the case, is evident from the following proposition:—

"Let ABC, fig. 3, be a cord or string, void of weight, and suspended freely between two fixed points, A and C; take B the origin. Suppose pressures applied to this curve, and let $P_2Q$ be a line representing the direction of one of these pressures, and $(y_2-y)=a(x_1-x)$ its equation, where $x$ and $y$ are co-ordinates to the point P, through which it passes; draw $P_1T$ a tangent to the curve at the point P, so that

Fig. 3.




$$(y_2-y)=\frac{\frac{dy}{dx}-m}{1+m\frac{dy}{dx}}(x_1-x) \text{ where } \tan.^{-1}m=\angle P_1P\ P_2$$

Now, I say that the smaller $\tan^{-1}m$ is, the less is the tension beyond the point P; and, finally, when $\tan^{-1}m=\tan^{-1}0$, or $\tan^{-1}a=\tan^{-1}\frac{dy}{dx}$, the equation becomes $(y_2-y)=\frac{dy}{dx}(x_1-x)=(y_1-y)$, that not any tension at all exists between the point P, and the point at which the axis intersects the curve, and consequently the segment PB may be removed without at all affecting the equilibrium of the segment PC."

"Let $\tan^{-1}m=o$, when the direction will be in a tangent, to the curve at the point P. Suppose the force to be the resultant of two other forces, acting parallel to the axes $x$ and $y$. Draw PS, SU, making $PS(=x_1-x)$, represent the force in the direction of the axis of $x$, and $SU=y_1-y=$the force parallel to the axis of $y$; when

$$U=\left\{(x_1-x)^2+(y_1-y)^2\right\}^{\frac{1}{2}}=(x_1-x)\sqrt{1+\frac{dy^2}{dx^2}}$$

where U=the tension in P T.

But at the point P, and for an indefinitely small space, P $h$, the curve coincides with the tangent, and the sine of the angle at which it cuts the ordinate is $=\frac{\frac{dx}{dy}}{\sqrt{1+\frac{dx^2}{dy^2}}}$, and since $x_1-x$ represent the force in the direction of $x$,

$$\text{Tension in the indefinitely short space P}h=\frac{\frac{x_1-x}{dx}}{\frac{dy}{\sqrt{1\times\frac{dx^2}{dy^2}}}}=(x_1-x)\sqrt{1+\frac{dy^2}{dx^2}}=U$$

Now, if it be possible for any force to exist in the curve beyond the point P towards B,—an equation to it from the obtained data can be constructed. Let it be constructed, and put $U_1$ = this unknown force; then

$$U_1 = \{U^2 + U^2 + 2U^2 \cos TPh\}^{\frac{1}{2}}$$

But, T P and P $h$, are connected at the point P, and are in the same straight line, consequently, $\angle$ T P $h = 180°$, and $\cos 180° = -1$; hence

$$U_1 = \{2U^2 - 2U^2\}^{\frac{1}{2}} = 0$$

Whence, it appears impossible that any force can exist in the segment P B, and the proposition is thereby demonstrated. This might have been obtained with a less formidable array of symbols, but I have taken the proposition as it was written. It has a more extensive reading than the one just now enunciated, and this must explain the reason why differential expressions have been introduced.

There is another portion of the structure to be examined, which has not yet (in this paper) been alluded to. It has been shown above, that by the action of the oblique suspending bars a great amount of tension is removed from the chains; this tension is transferred to the platform; so that the platform, or roadway, becomes an essential feature in the bridge, besides merely resisting the transverse strain of the passing load. The strain which is resisted by the horizontal line or platform is the *horizontal force* of the bridge, so that the roadway is as essential to the support of the structure as are the chains themselves. It is not necessary to increase the section of the platform in consequence of its having to resist the *horizontal force*, for its dimensions must be limited by the circumstances of the traffic, and as these dimensions would always be in excess sufficient to resist the *horizontal force*, it is only requisite to construct the platform so as to take advantage of the section so presented. Nay, in large structures, the platform may be lighter in consequence of the *horizontal strain being more efficient to prevent undulation* than *the heavy trussing and cross planking, which are used in the old system for that purpose. Indeed, in extensive structures, in consequence of this, the saving of material from the platform is greater than that shown in the chain above.* But to proceed. The strain in the platform equals the suspended weight of half the bridge, multiplied by the cotangent of the angle which the direction of the resultant of the forces at the points of suspension would make with the horizontal less the tension in the centre link.

Then, since the whole suspended weight is $= \mu L = \frac{\mu_2 S Z}{2}$, and the cotangent of the resultant of the forces would be $= \frac{g_1}{r}$.*

$$\textit{The horizontal force in platform} = \frac{g_1}{r}\left(\mu L + \frac{\mu_2 SZ}{2}\right) - \frac{\mu S \text{ sin. } (a_1 - \phi_0)}{\text{sin. } a_1 \text{ sin. } \phi_0}.$$

Substituting the value of $g_1$ (see note) and reducing

$$\textit{horizontal force in platform} = \frac{L}{2r}\left(\mu L + \frac{\mu_2 SZ}{3}\right) - \frac{\mu \delta \text{ sin. } (a_1 - \phi_0)}{\text{sin. } a_1 \text{ sin. } \phi_0}.$$

Example. Let the suspended weight of one half the bridge be

$$331{\cdot}15 \text{ tons} = \left(\mu L + \frac{\mu_2 SZ}{2}\right), \text{ then } \left(\mu L + \frac{\mu_2 SZ}{3}\right) = 324{\cdot}93 \text{ tons, an}$$

$$\frac{L}{2r}\left(\mu L + \frac{\mu_2 SZ}{3}\right) = \frac{250}{2 \times 41{\cdot}82}\ (324{\cdot}93) = 971{\cdot}016 \text{ tons.}$$

$$\text{And since } \frac{\mu \delta \text{ sin. } (a_1 - \phi_0)}{\text{sin. } a_1 \text{ sin. } \phi_1} = 16{\cdot}275 \text{ tons.}$$

$$\textit{Horizontal force in platform} = 971{\cdot}016 - 16{\cdot}275 = 954{\cdot}741 \text{ tons.}$$

To resist this force, I should have; 1st, four wrought iron beams, which form the foundation of the roadway, and pass from end to end of the bridge, the

* Now, since the action of the weight which the direct oblique bars, from the lower, have to be considered, the centre of gravity of the platform becomes changed, and $g_1 = \frac{L\left(L\mu + \frac{\mu_2 SZ}{3}\right)}{\mu 2L + \mu_2 SZ}$

total section of the four beams at the centre would be 32 inches; 2nd, planking of the roadway, which would give a section of $20 \times 12 \times 3 = 720$ sectional inches; and, 3rd, the iron balustrades which would give about 10 square inches. Hence $32 + 10$ sectional inches of iron, at 10 tons per square inch, will give 420 tons; and $954{\cdot}741 - 420 = 584{\cdot}741$ tons; to resist which, 720 sectional inches of planking is provided, which is capable of supporting with safety four times such a load.

It is singular that no one has ever discussed the economy of the oblique suspending bars: the fundamental principle of my bridge has never been objected to. Innumerable have been the discussions on the propriety of tapering the chains, but invariably have my opponents confined their observations to that alone, whilst the action which induced that variation has not even been alluded to by them. If a mathematician object, it is because the equation of the catenary does not agree with my chain; though, if he were to consider the difference of action in the suspending bar of the two systems, he would soon see that an agreement in their equations was impossible. Some say I do not put enough material at the centre of the chains. This is not an objection to the principle, but only to the form (which I think preferable, and therefore) I adopt. Experience has shown me, that the greatest advantage is obtained by carrying the principle out to near its limit, but I still retain the power of using it in a less extended manner. I can adopt 0, or any definite section of iron at the centre; I prefer 0, because it is more economical, and equally secure, and therefore approach it in practice nearly. I usually, at the centre, have only a single bar of the same dimensions as the bars in the rest part of the chain, but if peculiar circumstances, (though I don't know any that would,) induce me to use a greater section, I should do so without departing from "the principle" I advocate. *At first I did not* taper the chains to the extent I do now. Take for instance, the Victoria bridge, in which the section of the chains at the centre is *four* times as great as I should use now in a similar structure, and yet *that bridge is none the stronger for it.*

The Table on the opposite page is computed of the proportions, which in practice I have always found best, and therefore adopt. At the same time, I can vary these proportions as much as I please if peculiar circumstances show the propriety of it.

Column 2, in the Table, is the span divided by the deflection of the chains; 3 is the angle of suspension; 4, section of chains at base; 5, weight of semi-chain. The several columns are deduced from the formula at the head, in which the symbols are of the same signification as in the preceding pages.

To explain the use of the Table. Divide the span of the bridge with the deflection of the chain, which find in column 2. Multiply the numerator of the fraction in 4 (opposite the number found) by the semi-span drawn, into the weight of each lineal foot of platform in tons, and divide the product, less the semi-span, and the result will be the section of the chain required. If the weight of the semi-chain be wanted, multiply the numerator of the fraction on the same line in 5, by the square of the semi-span, and by the weight of each lineal foot of platform, and divide by the denominator less the semi-span. If the quotient of the span divided by the deflection be not exactly found in 2, take the two nearest numbers that are, and approximate from them.

*Example.*—Let span of bridge be 800 feet, deflection of chains 50 feet, weight of each square foot of platform with assumed load, 168 lbs., width of platform 20 feet; then $20 \times 168 = 1{\cdot}5$ tons per lineal foot.

$$\frac{800}{50} = 16\text{; opposite 16 in (4) stands } \frac{1166}{2783}\text{; then}$$

$$\frac{1166 \times 1{\cdot}5 \times 400}{2783 - 400} = \frac{699600}{2383} = 293{\cdot}6 \text{ sec. in.}$$

If the weight of chain be required,

$$\frac{{\cdot}875 \times 1{\cdot}5 \times 400^2}{2783 - 400} = \frac{{\cdot}875 \times 240000}{2383} = 88 \text{ tons.}$$

| | | New System. (The proportions I think preferable.) | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| No. | $\frac{2L}{r}$. | $\phi = \text{cot.} -\frac{q}{r}$. | $S = \frac{q \mu l}{m \sin. \phi - \frac{q \mu_2 Z}{2}}$. | $W = \frac{S \mu_2 Z}{2}$. |
| 1 | 20 | 9°41′ | $\frac{1199}{2343}$ | $\frac{\cdot 9}{2343}$ |
| 2 | 19 | 10°11′ | $\frac{1193}{2357}$ | $\frac{\cdot 895}{2357}$ |
| 3 | 18 | 10°45′ | $\frac{1185}{2373}$ | $\frac{\cdot 888}{2373}$ |
| 4 | 17 | 11°21′ | $\frac{1176}{2394}$ | $\frac{\cdot 882}{2394}$ |
| 5 | 16·5 | 11°41′ | $\frac{1171}{2700}$ | $\frac{\cdot 879}{2700}$ |
| 6 | 16 | 12°3′ | $\frac{1166}{2783}$ | $\frac{\cdot 875}{2783}$ |
| 7 | 15·75 | 12°14′ | $\frac{1164}{2825}$ | $\frac{\cdot 873}{2825}$ |
| 8 | 15 | 12°49′ | $\frac{1156}{2958}$ | $\frac{\cdot 866}{2958}$ |
| 9 | 14·5 | 13°14′ | $\frac{1149}{3052}$ | $\frac{\cdot 862}{3052}$ |
| 10 | 13·75 | 13°56′ | $\frac{1139}{3211}$ | $\frac{\cdot 854}{3211}$ |
| 11 | 13 | 14°43′ | $\frac{1128}{3387}$ | $\frac{\cdot 846}{3387}$ |
| 12 | 12 | 15°53′ | $\frac{1111}{3649}$ | $\frac{\cdot 833}{3649}$ |
| 13 | 11·5 | 16°32′ | $\frac{1101}{3793}$ | $\frac{\cdot 826}{3793}$ |
| 14 | 11· | 17°15′ | $\frac{1091}{3953}$ | $\frac{\cdot 818}{3953}$ |
| 15 | 10·75 | 17°57′ | $\frac{1085}{4034}$ | $\frac{\cdot 814}{4034}$ |
| 16 | 10·25 | 18°25′ | $\frac{1073}{4213}$ | $\frac{\cdot 804}{4213}$ |
| 17 | 10 | 18°52′ | $\frac{1067}{4312}$ | $\frac{\cdot 8}{4312}$ |
| 18 | 9 | 20°46′ | $\frac{1037}{4727}$ | $\frac{\cdot 777}{4727}$ |
| 19 | 8·25 | 22°28′ | $\frac{1010}{5094}$ | $\frac{\cdot 758}{5094}$ |
| 20 | 8· | 23°6′ | $\frac{1000}{5231}$ | $\frac{\cdot 75}{5231}$ |

## THE DISCOVERY OF THE ADVANTAGE OF WORKING STEAM EXPANSIVELY.

Sir,—The account, in No. 1167, of Watt's patent, in 1782, for the expansion of steam, with several plans for the equalization of its action, can afford no grounds for Watt's claim to the original discovery of the advantages of expansion.

since Jonathan Hornblower, in 1781, the preceding year, had taken out a patent for expansion of steam in a double cylinder engine, by which means its action was in a considerable degree equalized.

Watt's claim to originality is founded on a letter written ten or eleven years previous to his patent, and on his experiments on the Soho engine in private, as well as at the Shadwell water-works. And these amount no more to a publication of expansion of steam, than Mallet's sealed letter respecting the formation of atmospheric railway vacuum, by means of the condensation of steam, does of his plans.

Hornblower and Nasmyth are in the same position as original patentees of their respective schemes.

Watt's superiority is enhanced by showing that some, at least of his engineering competitors, were capable of fully appreciating the properties of steam. Hornblower's subsequent infringement of Watt's patent, in using the separate condenser, &c., &c., for the purpose of rendering his own unquestioned patent right of expansion, practically available, received its due share of punishment, and the engines he erected in Cornwall, were compelled to pay coal savings for the use of Watt's condenser.

These engines are still partially in use under Woolf's name, who made them double-acting, and introduced high steam. Other modifications of double cylinder engines, are now in the course of trial—witness the great Harlaem engine, in Holland.

I remain, your obedient Servant,
S. S.

January 13th, 1846.

### STEAM VACUUM.—CARSON'S PATENT.

Sir,—Mr. Carson complains that my arguments are fallacious, but it is only he who makes them so.

I stated distinctly, that *the apparatus* described as fig. 8, in Mr. Carson's specification, *was old*, but that *its application* to atmospheric railway *was new*, and it is this application, or combination, which Nasmyth and May claim; and this I still maintain to be perfectly valid, according to our existing patent laws.

The validity of Mr. Carson's patent must now rest on his specification, and on that alone; it was after attentive reading that document, that I formed the opinion I did, and this I am glad to find coincides exactly with your own, Mr. Editor.

The title is "for improvements in withdrawing air *or vapour*." I have already shown that, as regards fig. 7, the invention claimed is old, Mr. Carson takes no notice of this—he probably thinks, that "least said soonest mended." I have also shown, that an apparatus, similar to fig. 8, has been used and patented, *for withdrawing air or vapour*: this also is unnoticed.

I would remind Mr. Carson that there is nothing whatever in his specification to indicate what were his contemplations, when he visited Wormwood Scrubs, in 1839, save and except "the *other place*," which I may fancifully assume, to mean a very different place from the tube of the blow-me-tight! If he contemplated the use of this, fig. 8, to atmospheric railways, why was there not the slightest mention of it in his specification, which in its preamble refers only to a chimney or other shaft?

Your obedient Servant,
R. S. NEWALL.

Gateshead, January 13th, 1846.

### THE STEAM VACUUM.—ANOTHER CLAIMANT.

Sir,—Observing so much said about the claims of Mr. Carson, Mr. Mallet, and Mr. Nasmyth respectively, to the original invention of the principle of direct exhaustion of tubes by steam, for atmospheric railways, I am induced to put in a word on behalf of an anonymous contributor to your Journal, who appears to me to have a better claim to the invention than any of them.

In the *Mechanics' Magazine*, of the 23rd of March, 1844, will be found a letter, signed "A. S., Lincoln's Inn," and dated March, 1844, in which he describes, succinctly, but most clearly, a simple and efficient means of providing vacuum in a chamber, communicating with the tubes by the direct action of steam. His chamber, besides, has the advantage of separating the steam from the air, and thus preventing waste. Whether this publication of A. S.'s may affect Mr. Nasmyth's claim, I do not pretend to say; however, I think it only justice to A. S., that it should be known his was the first publication on the subject.

I am, Mr. Editor, yours truly,
GEO. ROBINSON.

January 8th, 1846.

### TRIHEDRAL ANGLES.

Sir,—As the construction of oblique works, especially bridges, requires that the three faces of a stone at each angular

point, shall be formed of oblique angles, will you oblige me by pointing out any work in which the construction of solid angles, subject to determining conditions, is satisfactorily treated? The only English work, in which I can find the slightest notice of the subject, is *Nicholson's Masonry;* and in this work only the "*right angled trihedral*" is constructed; and this does not meet, in the slightest degree, the wants of the scientific engineer of the present day.

It is possible that this subject has not been treated by any English writer; whilst it might have been by foreign ones. Should this be the case, perhaps you would be kind enough to state when, and give me some idea of the price of the work, provided it be one which can be obtained. If, however, it is only to be obtained from foreign works, I would suggest that you would be rendering a real service to many of your readers, by giving the complete discussion in your Magazine; as few of them have either the pecuniary means, or the preliminary acquirements to render such a source of information available.

I have the honour to be, Sir,
Your constant reader,
A STUDENT OF ENGINEERING.

January 17th, 1846.

[In reply to our correspondent we would remark, that his conjecture is correct as to English works on the subject of his inquiries. There is no English writer besides Nicholson, who has treated of "stone-cutting" with even an *air* of science; and we are not aware of any work of his, in which the general problem has even received the semblance of discussion. Several foreign writers, of whom Hachette appears to have been the first, have given complete solutions of the problem; though the forms in which they are given would scarcely be intelligible to an English engineer. We will take an early opportunity of complying with our correspondent's request, as we are convinced that we shall be doing a service to the profession. We shall at the same time notice one or two English publications in connection with the oblique arch, to which this problem is more immediately subservient. Possibly some suggestions from our correspondent may aid us; for which we shall feel very thankful.—ED. M. M.]

## THE LIVERPOOL OBSERVATORY.*

We rise from the perusal of the pamphlets named below, and from the extracted sheet from the *Athenæum*, which accompanies them, with feelings of intense pain; and it is with deep shame that we contemplate the spectacle of personal malevolence that is displayed full twenty times, perhaps, through the entire correspondence. The spirit of the letters on both sides is bad enough: but what will any unprejudiced looker-on, who reads this "correspondence" without any knowledge of the circumstances but such as is here furnished, say to the foot notes and commentaries? We, ourselves, can see in them nothing short of the most concentrated—we had almost said cowardly—hatred on the part of the "Fellow of Trinity" towards the merchant of Liverpool. We sincerely wish, for the honour of science and of human nature, that we could view it otherwise. We have tried, and tried again, to find some other construction of this correspondence, but in vain!

It appears that, several years ago, Mr. Taylor, who is a merchant of considerable standing and influence in Liverpool, conceived the idea of establishing an observatory upon a scale commensurate with the wealth and importance of that magnificent emporium of commerce; and that he made a communication of his views to the Lords of the Admiralty, who returned him a polite official answer in suitable style of official ambiguity. Now every locality has its factions, and Liverpool, it appears, furnishes no exception; and when the British Association (that great absorbent of all schemes which are likely to produce a little *eclat*) met there, the matter was brought under consideration of that body, *pro forma*, by an agent of the town-council; talked about a

* "Correspondence respecting the Liverpool Observatory between Mr. John Taylor and the Rev. R. Sheepshanks, M.A., Fellow of Trinity College, Cambridge, member of the board of visitors of the Royal Observatory; Foreign Secretary of the Royal Astronomical Society; F.R.S., F.G.S., F.P.C.S., etc., Author of the articles on Practical Astronomy in the Penny Cyclopædia."

"Supplement to the correspondence respecting the Liverpool Observatory, between, Mr. John Taylor of Liverpool, and the Rev. R. Sheepshanks."

"The Athenæum, October 11, 1845."

few minutes, and referred to a committee. The Royal Astronomical Society of London was, of course, consulted—the town-council wishing to do as little as they could whilst they defeated any larger scheme; and the Astronomical Society duly apprised that the objects in which the more *direct interests* of the merchants were concerned, would alone be provided for (the time, and the rating of chronometers) suggested a plan for executing these objects. A site was fixed upon, the observatory erected, and the assistant-secretary of the Royal Astronomical Society was appointed director. A report was issued by the council, in which was a paragraph laudatory of the observatory, its instruments, and its director, from the pen of Mr. Sheepshanks; and upon this passage some smart sarcasms were made in one of the Liverpool papers from, as it afterwards appeared, the pen of Mr. John Taylor—having especially reference to the *site* of the observatory. In ordinary cases this might have passed as the little local squib of the day and been then forgotten; but Mr. Sheepshanks appears to be of that combustible constitution, that the smallest spark of irony sets him in a blaze; and any man who wishes to see what a man in a passion can do and say, or how he can do and say it, has only to wade through these one hundred and thirty closely printed octavo pages. Mr. Sheepshanks appears as champion general of the Royal Astronomical Society,* the Royal Society, the Astronomer Royal, the Liverpool Observatory, and its director, the town council of Liverpool, the Rev. Mr. Hawes, the Rev. Richard Sheepshanks, of the sparkling "tail:" and his tilting is worthy of the most valorous days of chivalry, at the Liverpool merchant, the Liverpool editor, Sir James South, and a thousand shadows in the columns of Sunday newspapers!

We are far from justifying Mr. Taylor's somewhat flippant remarks on the several topics. He is a ready, off-hand writer; he is admitted to be well read in the history of ancient astronomy; he is a man of local influence, and of sterling personal character. His great fault is, that he is opposed to the narrow views with which the Observatory was established (and in this he is not solitary), and to the site† which has been se-

* We entertain for the objects of the Royal Astronomical Society, we trust, a becoming respect, and for many of its Fellows, whom we know, a profound personal esteem; yet we cannot be blind to the fact that it is still a *human* society, and subjected, like all others, to its alloys. A fellowship of this society implies nothing more of astronomical science than the ability to pay the fees; as, though there is the *form* of a ballot for admission, there is certainly no exclusion of any candidate, except he shall be personally disliked by some influential member of the society. All this arises from the necessity of raising the funds required for the society's operations by means of actual subscriptions from the public; and on no other grounds than the assumption of the symbols F.R.A.S., will the lieges contribute those funds.

In this country there is not given the least *direct* public support to science of any kind, apart from certain conditions of a nature totally extraneous to scientific ability; and before we censure this indiscriminate admission of signatures to the society's roll, we ought to ask ourselves whether it be not better that even under these disadvantages, astronomical science should be cultivated, than that it should be neglected altogether?

One unfortunate consequence, however, of this mode of raising the necessary funds, is, that a penurious economy becomes inevitable. The secretaryship, for instance, has constantly "to go a begging;" as the time which it occupies can be seldom spared from imperative social duties without remuneration. We have been, indeed, informed that there has been a secretary who could not distinguish $\alpha$ Lyræ from $\varepsilon$ Bootes, an equatorial from a transit, or even a theodolite from a sextant! Without vouching for the truth of this statement, we feel certain that persons *astronomically* unfit for the important office of secretary, may be induced for the sake of a little ephemeral reputation, to assume the office. It is, therefore, much to be regretted that the Premier does not place the society on a healthier footing in respect to its means. The 300*l.* a year which has for the last fifteen years been paid to Sir James South for doing nothing, would have made it worth the while of men of astronomical talent and reputation to accept the secretaryship of the Royal Astronomical Society. But premiers know little about science, and perhaps care still less; and such a grant would, in these times, require close looking after to prevent a "job."

† "According to the writers of the Royal Astronomical report the proper situation for our observatory is in the lowest point of land that can be found, surrounded by hills that cut off the true horizon, and where in fact there is no horizon at all, although, to be sure, when the trough of the river is filled with smoke and fog, which is commonly the case, there may seem to be a horizon at a few yards' distance; where the view is immediately interrupted by the masts of ships, by immense and high warehouses only 200 yards distant, and with the expanse of the sky from the north by east to the southern point constantly filled by the mass of the town, and the smoke constantly lodged over it; where nor sun, nor moon, nor star, is ever seen, or were ever seen to rise or set, and where no meridian line can be drawn or determined; and 'on the brink of the Mersey' too, by their own confession, exposed on a foundation of red sand-stone rock, for ever cracking, to the furious attacks of the surge rolled in from the north-west by the storms so frequent here."—*Mr. Taylor's Letter*, 1st *April*, 1845.

lected for it; whilst his very limited knowledge of the *practice* of modern astronomy, has led him into forms of expression, that furnishes his adversary — we may speak plurally, for Mr. Sheepshanks, though his only ostensible adversary, is only one of a "legion"—with data for the most unsparing, coarse, and vulgar ridicule. There must be some secret cause which does not meet the public eye for the accumulated vituperation. There must be some *grand motive*, some *great interest*, at stake, to induce Mr. Sheepshanks to depart so widely from all precedent in conducting a quarrel with persons so obscure in the world of science as Mr. Taylor and the editor of the *Liverpool Mercury* are presumed by him to be. His own account of his motive is not in keeping with the spirit of the book—at least, we can see no keeping between them. This very attempt to perpetuate the "good hiding" by publishing it entire with his own vituperative additions in foot notes, and otherwise is, it appears to us, un-English and unmanly:—it is, at any rate, a piece of ungenerous triumph, a cruel modernizing of the barbarous Roman dragging his captive opponent through the public streets attached to his triumphal chariot! The vulgar crowd look on and mock—his scientific bottle-holders clap him on the back, with a "Bravo! bravo! Sheepshanks!" We think such scenes disgusting; and we believe that many of the reverend disputant's friends will consider the publication to be in bad taste, and in worse feeling.

That Mr. Taylor's character as a *practical* astronomer is completely annihilated, there can be no doubt; but we are at a loss to divine the real motive for all this apparently *personal hate*, or to judge of the interests which were so evidently involved in accomplishing *his* destruction. If there be nothing beyond what meets the eye, we must be struck with the immense disproportion between the means employed and the object to be accomplished. Can it possibly be that the object of the pamphlet is to produce some *local* injury to Mr. Taylor? In fact, we know not what to think; and we shall be glad if any one will enlighten us. We shall be gratified to find any interpretation less calculated to inspire disgust than those which force themselves upon us: but we doubt whether any interpretation can justify this cruel outrage, this "hilting" of his sword into the mangled body of his fallen foe!

That the frequent occurrence of the coarse jokes of the day, or the scarcely less undignified quotations from Sam Weller and Fanny Squeers, with which Mr. Sheepshank's pamphlets abound, may serve as "clap-traps" in such a cause, we admit; but that it comports with the character of a scientific discussion, we think few persons of correct taste and good feeling will contend. Had his cause demanded a discussion in any form, the adoption of such a style would inevitably nauseate all *impartial persons*. It is unworthy of the man of education, of the man of science, and above all, of the man who is invested with the sacred functions to which Mr. Sheepshanks has been ordained as a minister of religion.

## SCREW PROPELLING.

Sir,—I beg the favour of a corner in your valuable columns, for a few lines, in reply to your correspondent T. W.'s letter.

T. W. very much doubts the success of a screw propeller working within a tube running from stem to stern of a vessel, because the friction of the water passing through a tube of such a length, would prevent any considerable velocity being gained.

I had, at first, the same fears on this head as your correspondent, but I got over them (in idea) in this way. I proposed, to myself, to make the tube tapering more at one end than the other, and to pass the smaller end through the stem, and the larger through the stern-post; and, further, that the tube should be smoothly painted inside, and varnished if necessary, to allow the water to slide smoothly through it. The tube being tapered, and the water entering from the narrowest end, would produce but very little friction; and whatever the amount of friction might be, it would be greatly compensated, by the even and regular motion which a propeller, so fitted, would have.

I am, Sir, your obedient Servant,

L. GACHET.

Coggeshall, Essex, January 8th, 1846.

### NOTES AND NOTICES.

*Test of Indigo.*—M. Fritsche, of St. Petersburgh, has communicated to M. Chevreul the following method of testing the value of commercial indigo:—Take 1 part of commercial indigo and 1 part of grape sugar, and place them in a flask capable of containing 40 parts of liquid. Fill half the flask with hot alcohol, and then add 1½ parts of strong liquid caustic soda to another equal portion of alcohol, and fill up the flask with them. The flask thus filled is to be allowed to remain at rest till it becomes clear. The fluid is then withdrawn, by means of a syphon, into another flask. This liquid is first yellow, but, by exposure to the air, it changes to red, violet, and blue, depositing microscopical crystals, which are larger in proportion to the gradual admission of the oxygen of the air, and consist of pure indigo. They are then thrown on a filter, and washed rapidly with hot water, in order to remove a substance produced by the action of the soda on the sugar, which is insoluble in alcohol, but soluble in hot water. From 4 ounces of inferior indigo of commerce, M. Fritsche obtained, by the first infusion, 2 ounces of pure indigo blue; a second infusion of the residue gave only a drachm of indigo.

*Tyrian Purple.*—M. Bizio, of Venice, has lately, in a communication to the French Academy, given a description of the shells which supply the Tyrian purple, a dye of great celebrity among the ancients, and has sent specimens of these shells to the same society, along with a quantity of the fluid procured from the shells. The Tyrian purple is contained in the *Murex Brandaris:* the amethyst purple in the *Murex Trunculus:* two shells which are very abundant on the shores of the Mediterranean. The liquid is contained in a large bag, which is situated at the upper part of the animal, and may be extracted with great facility. All that is necessary is to break the shell with a hammer, and express the liquid from the bag by means of a spatula. The Roman dyers break the shells in their oil mills. The liquid, which is white and milky in the bag, oxidizes in contact with the air and light, and passes through all the shades of green to a more or less deep red.

*Chinese Grass a Substitute for Sheep's Wool.*—An experiment has been made in this place to manufacture cloth from a mixture, we believe in about equal proportions, of Chinese grass and sheep's wool. The success of the experiment cannot as yet be pronounced upon with certainty, but one of the great difficulties has been overcome, namely, the possibility of felting; and it is shown that a piece of cloth made from these materials, of the width of 108 inches, has, by the application of the felting stocks, been compressed to the width of 53 inches. —*Leeds Mercury.*

*Turquoise Mine.*—A Russian company has obtained from the Persian Government, for a small annual payment, the privilege of working the turquoise mines of Nichapour, in the province of Khorassan. The stones found there are the finest in the world for quality and size. When these mines were first opened, one turquoise was found there of so large a size that it could be turned into a cup for the father of the reigning monarch.

*Ship Railway from the English Channel to the Mediterranean.*—M. Guillemon, an officer of engineers in France, has conceived the gigantic project of making a railway which shall unite the Mediterrean with the Channel—say from Toulon to Cherbourg—along which may be transported ships and fleets of war from the one point to the other on occasion. It is observed that England, being in possession of Gibraltar, might materially obstruct the passage of French vessels through the Straits in case of war, and thus impede the junction of fleets and the conveyance of reinforcements, which might become necessary for the success of naval operations. The plan, not developed at length, consists in its outline of a submarine sort of tunnel to be made under the railway, which, by an incline of the latter, might at some certain point bring the ship to and upon the level of the line. It remains to be seen how such a project could be worked out, considering the breadth and height of a ship, and also its weight. The latter is estimated at 2,700.000 kilograms, which would give a current pressure of 45,000 kilograms upon the rail, which the rails actually in use support only 5,000.—*The Daily News.*

*Magneto-atmospheric Railway.*—Locomotion at the present time appears to be occupying the minds of nine-tenths of the community, and scarcely a week passes without some infallibly superior scheme being added to those already proposed—travelling by air, by steam, and by ropes—something new every day. Now we have a combination of the atmospheric and electro-magnetic powers — not that electro-magnetism is to be employed as a power in moving the train, but as a means of attaching it to the piston in the atmospheric tube, to obviate the necessity for an opening in the tube, and consequently to do away with that troublesome and expensive appendage the valve. All who are in any way acquainted with the phenomena of electro-magnetism will remember that a bar of ordinary soft malleable iron, bent into the form of a horse shoe, and covered with insulated copper-wire bound round it, may be instantly converted into a powerful magnet by passing through the copper wire a stream of galvanic electricity. The current passes at right angles to the axis of the bar of iron, and it becomes a magnet by induction. A magnet of this kind is powerful in comparison to its size and the intensity of the galvanic current passing through the wires; and such a one is capable of exerting the influence at a considerable distance. In the Magneto Atmospheric Railway such a magnet as this is employed, and the first carriage of the train, or that which would ordinarily be fastened to the piston, will be devoted to the necessary apparatus. Fixed to this carriage will be several large bent iron bars, capable of being converted into magnets of an attractive power of many tons. These bars prepared with the coating of copper wire, will descend to within a very short distance of the upper part of the tube, in which, in the place of the valve, a thin sheet of copper will be placed. This will be continuous along the line, bolted down on either side, and perfectly impervious to the external air. The iron bars fastened to the carriage may in a moment be rendered magnetic by making a connexion between the copper wires which surround them and strong galvanic batteries ready in the carriage; the moment the connexion is complete the bars become magnets, and will attract iron brought into proximity to them; the piston in the tube is furnished with bars of iron which ascend and almost touch the under surface of the thin copper in place of the valve, and the magnets above and the iron bars on the pistons below are separated only by a distance of perhaps three-fourths of an inch. When the carriages are ready for starting the bent bars above are rendered magnetic, and powerfully attract the bars upon the piston in the tube; the piston is set in motion by the atmospheric pressure against a vacuum, and when it moves its strong attraction for the magnets in the carriages causes the train to move along the railway. A model of this invention will, we understand, be soon submitted to the public.—*Daily Newspapers.* — [The invention alluded to is the subject of a patent recently granted to Messrs. Conder and Taylor, but not yet specified. —ED. M. M.]

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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1173.] SATURDAY, JANUARY 31, 1846. [Price 3*d*.

Edited by J. C. Robertson, No. 166, Fleet-street.


## DESCRIPTION OF AN IMPROVED SYSTEM OF RAILWAY CARRIAGE BUFFERS. BY MR. JAMES DELL.

Fig. 1.

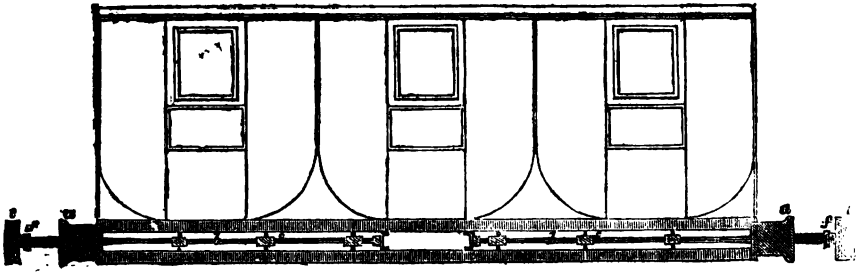


Fig. 2.

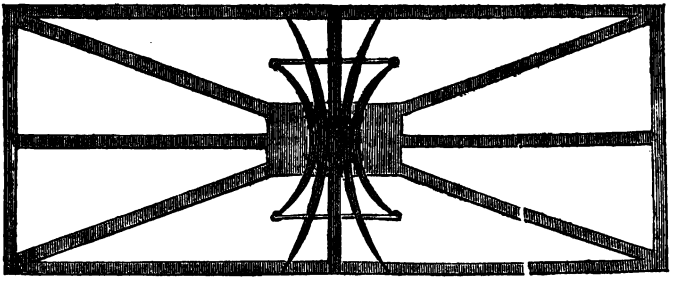
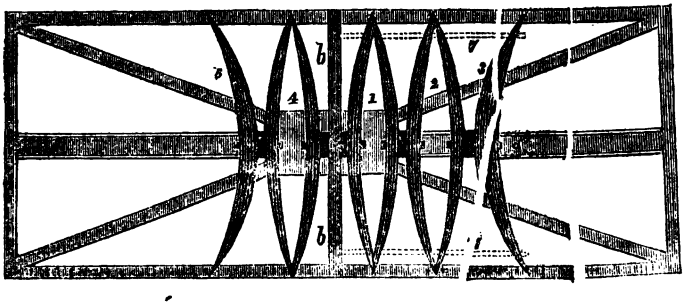


Fig. 3.



## DESCRIPTION OF AN IMPROVED SYSTEM OF RAILWAY CARRIAGE BUFFERS.

BY MR. JAMES DELL.

After having paid considerable attention to the action of the buffers in use on railway carriages, I have arrived at a conclusion diametrically opposed to the opinions expressed by writers on the subject; who one and all agree in what I consider a fundamental error; namely, *that it requires something highly elastic to make a good buffer in extreme cases of collision.* I cannot conceive anything that would so soon bring a train to a stand, with so little a shock or injury, as a huge lump of soft plastic clay for each carriage to run its head against in such cases, and anything less elastic it would be difficult to find. But as that may be considered impracticable; or, indeed, quite out of the question to think of trying, let us see what we can produce as a substitute, by such means as come within our reach, and as shall act in a similar manner without rebounding.

The steel springs now in use answer very well for common stopping and starting at stations, as the weight of the carriages are great in comparison with the shock so received; but when a violent collision takes place — when the same steel springs are driven back to their full extent — the case is different altogether, and requires a different arrangement to meet it, as the reaction which takes place is tremendous, and the luckless carriage that happens to be between the impinging and resisting forces, is thrown like "a bauble into the air." To prevent this, I propose to put a stop to such violent re-action by springs or catches, so arranged as to stop the buffer-springs at whatever point of tension they may have reached; and that an apparatus should be carried with each train to set them at liberty again.

The accompanying drawings and description will explain the method I propose to adopt; and also show a combination of elliptical and semi-elliptical steel springs, of different degrees of strength, that will give greater range to the buffer-rods, so that the force may not be all expended at once. If some one of our railway companies would institute a series of experiments on some side line, with old carriages prepared in the manner here proposed, by forcing a heavily laden carriage down an inclined plane, and at different distances, they might ascertain what strength of springs would be requisite to resist different weights, and different velocities; while the catches, by stopping the buffers at any point they may have reached, would register the force of impact.

### *Description.*

*First plan*; fig. 1 represents a side elevation of the body and buffers of a railway-carriage as commonly used, with the exception of the collar, or nut, *f*, on the buffer-rod, *b*. The cylinder, or guide, *a*, is to contain four springs, as shown in the section, fig. 4, *e* being the point of contact. In case of a violent collision taking place, the buffing-rod being driven towards the centre of the carriage, and the edge of the collar, *f*, coming in contact with the springs, *g*, (as shown in fig. 4,) will force them up; and instantly the collar is past, the whole of the reaction of the buffer-springs will be locked up. When it is desired to release them, the wrench, fig. 7, should be applied to the groove, *h*, in the collar, *f*, as shown in fig. 6, and by turning the collar one-eighth round, it will assume the form of fig. 5, in a line with the springs, *g*, and by the re-action of the buffers the whole will be placed in their former position, and ready for use. Fig. 9, is a portion of the end elevation of the carriage and buffers; and fig. 8 an apparatus which is intended to set the buffers at liberty after a collision has taken place. In fig. 8, A is a piece of timber the same length as the width of the end of carriages and buffers; *b b* are hooked screws to be placed through the timber, A, in fig. 8, and over the bed of the carriage *a*, in fig. 8; and by turning the nuts, *c c*, in fig. 7, this will allow the buffers to come gradually into their position for work again. In fig. 1, *c c c* are guides for the buffing-rods to work to and fro in; and *d* is a flanged collar fixed on the rod, *b*, and to press against the springs. Fig. 2 is merely intended to show the buffing and traction springs, and rod as now in use.

*Second plan*; fig. 3, is a side elevation of a carriage with improved buffers. By referring to the fig., it will be perceived, that the buffer consists of elliptical and

Fig. 4.

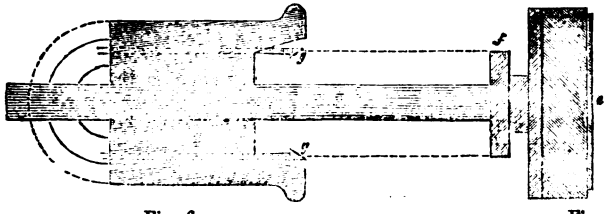



Fig. 5.

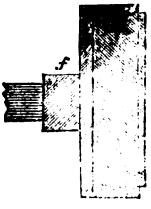



Fig. 6.

Fig. 7.

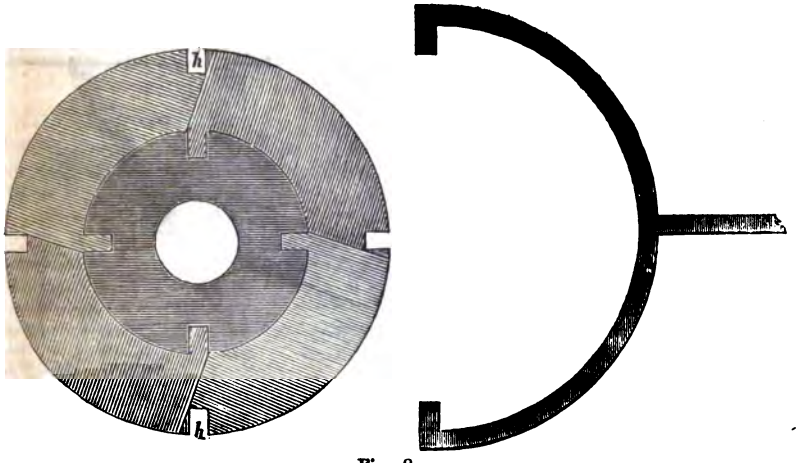



Fig. 8.

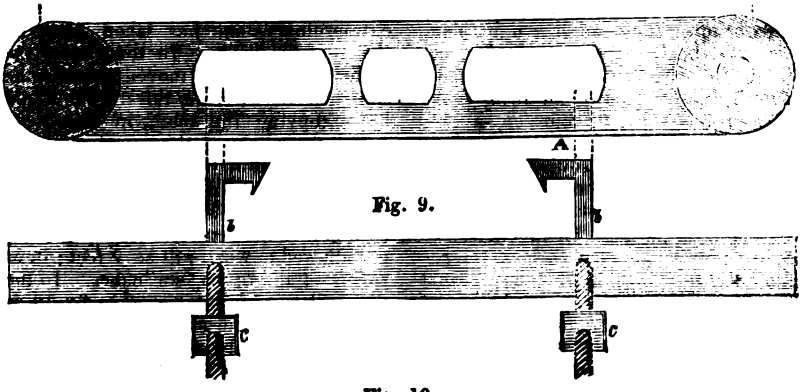



Fig. 9.

Fig. 10.

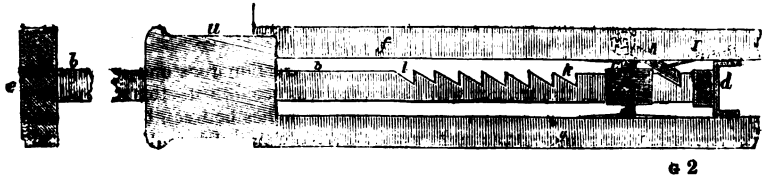


Fig. 13.

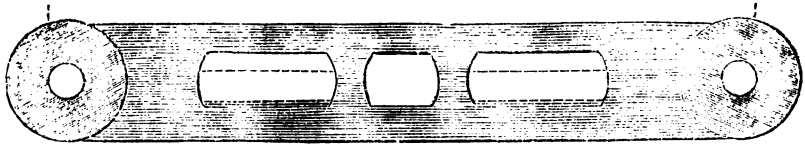


Fig. 12.

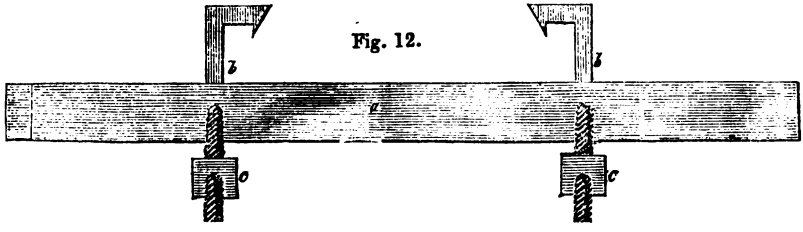
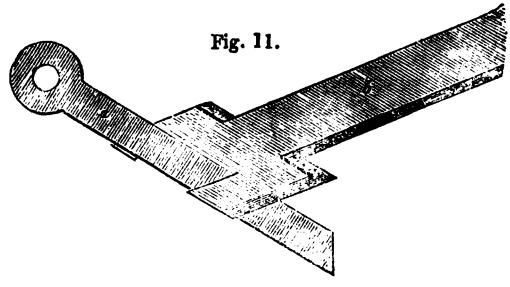



Fig. 11.



semi-elliptical steel springs, 1, 2, 3, for the whole width of the carriage. Each spring increases in strength as shown in plan, or as may be found necessary; for example, the spring 1 may contain 12 leaves from ¼ to ⅝ths of an inch thick, and 3 inches wide; 2, fourteen or sixteen; and 3, sixteen or eighteen. The first is intended to be of sufficient strength for common use, and the others to be brought into action when any unusual collision takes place. The rack on the buffing rod is intended to lock the reaction of the springs up when an unusual or severe collision takes place, by means of the trigger, or stop, *h*, in fig. 10, which is fixed in the centre of the bed or outside framing of the carriage, and kept in place by a forked spring, set in an opposite direction, as I, in fig. 10, or *b* in fig. 11; *a* of which is the trigger, and *b* the spring. After having received a shock sufficient to close the first spring, and a portion of the second, the trigger will be occupying the tooth in the rack, *k*; consequently, will have removed the buffing-rod 9 inches towards the centre of the carriage. By the same means they will admit of a series of shocks; unless an extraordinary one has taken place on the first occasion. In that case, the buffer-rod would be moved towards the centre of the carriage, the trigger would be occupying the tooth in the rack, *l*, and the whole of the reaction of the springs locked up until time admits to set them at liberty. If the two elliptic and the semi-elliptic springs are used on each end of the centre, the length of the rod allowed to work will be 2 feet; if, as springs 4 and 5, sixteen inches. In the centre piece of framing at *a*, in fig. 10, is a groove, 3½ inches wide, 1½ inch deep, for the parting block to slide in, and to keep the springs in one steady parallel direction. The cross timber, *b*, in fig. 3, is to be worked into both beds of framing, and by which all the springs are connected.

The traction-rods and springs may be placed as usual; with this exception only, that 6 inches between bed and bottom of carriage would be required instead of 5 inches.

The dotted lines, 7, in fig. 8, are intended to indicate two springs which are to be screwed to the bottom of the carriage, and to press upon the springs to prevent their swaying up and down when the carriages are in action.

It may be necessary to state, that the same apparatus would be required to set the buffers at liberty in this, as in plan the first, as shown by figs. 8 and 9, 12 and 13.

JAMES DELL.

Dudsworth, Great Berkhamstead.

MISCELLANEA MATHEMATICA.—NO. IV.

## *Professor Davies and the Horner Manuscripts.*

Sir,—Your last Number has just been transmitted to me by a friend. I have no right to complain of the enquiry which you make concerning the manuscripts of my deceased friend; and will submit a few remarks in answer, promising that they shall be as brief as the subject will admit of.

I have never advertised, in the strict sense of the word, the intended publication of these MSS.; but I had given sufficient intimation, both verbally and otherwise, that I contemplated such a publication, and that I had in some considerable degree arranged the materials of it. I have made every possible effort to accomplish that object. I was, however, in every case where I applied amongst respectable publishers, met by a civil, but decided refusal to undertake it—except "by commission:" but I was not so circumstanced as to take upon myself, consistently with other and imperative claims upon my resources, the pecuniary risk of such a mode of publication.

I had thought of attempting to publish it by "subscription." A few applications, however, to persons from whom I might have expected liberal co-operation in such a case, led to the conviction that they preferred "a presentation copy" to paying the price of a single volume.

To Mr. Horner's bereaved family I felt that no proposition of a pecuniary kind ought to be made.

The MSS., therefore, await the chances of time and events; and I am not without a hope of their being ultimately laid before the world, in a form not much different from that originally contemplated. I am quite convinced that, though extremely disappointing to myself and Mr. Horner's other friends, this delay will not be injurious to Mr. Horner's reputation; but, on the contrary, when they do appear, that the mathematica world will be better prepared to appreciate their value than it was seven years ago. Much of this advantage has been conferred upon them by the candour and unwearied research of Professor de Morgan, to which you have yourself borne honourable testimony in the *Miscellanea Mathematica*.

You also make a reference to the *Mathematician*, and appear to think that I might have published the paper which was "rejected by the Royal Society in 1823," with greater rapidity. By a reference to our prospectus of that work, you will, however, see that it is published by subscription, and in a way, too, that precludes the exercise of individual predilections even to the most limited extent. You must recollect that I was only one of three editors whose powers were *co-equal;* and it might occur to you as possible that my colleagues may entertain views on particular subjects altogether different from my own; or even be subjected to influences which have no weight with me.* Allow me to state, broadly and distinctly, that the extreme slowness of the publication of that paper has not arisen from any "lukewarmness" on *my own part*. I beg, however, to intimate that the completion of the "rejected" paper is in the hands of the printer, and will, as I understand, be published in the March number of the *Mathematician*.

The last sentence suggests another remark. It is, that you do not seem to be aware that I have withdrawn from the editorship of that work. My direct connexion with it ends with the close of the first volume, published July 1, of last year: and the November number† would have shown that the work was conducted by Messrs. Rutherford and Fenwick alone. My retirement, however, is not to be construed into any feeling of indifference to the continued success of so useful and so desirable a publication. The work retains my most cordial good wishes, and will uniformly receive all

* See Editorial note at the end of Mr. Davies's letter.—ED. M. M.

† We had not seen that number when we made our remark.—Ed. M. M.

the aid from me which it is in my power to afford. The demands which imperative duties make upon my time, and my extreme repugnance to a joint responsibility, when unity of judgment may not always exist, have been my principal motives for withdrawing from all *editorial connection* with that work.

I trust, therefore, that your appeal to me in the cause alike of "science" and of "friendship," is satisfactorily answered; and that neither yourself, nor your readers will consider me to be growing "lukewarm" in a cause ever so dear to me, and never more dear than at this moment.

Permit me to add one word more of a personal nature respecting my humble self. It is suggested by your reference to a passage in Professor Christie's preface (p. xi.) in which my name is mentioned very pointedly. You will judge, that the passage had attracted not only my own attention but that of my friends; and we could come to no other conclusion, than that its *implication* (cautiously worded, it is true,) was most derogatory to my character. After due deliberation, and a somewhat extended intercourse and correspondence, I found that no one who was acquainted with my writings, or who knew me personally, attached the slightest importance to that passage, or considered it at all needful, that if I did commence a career of scientific pillage, for me to have recourse at least to Professor Christie. I was therefore induced by the representation of my friends to avoid the disrepute which would inevitably result from a public discussion on a topic so entirely personal. I have no cause to regret the adoption of that advice; and have every reason to be satisfied with the general decision of mathematicians on this question. Still, as you have in some degree challenged a public statement on the circumstance, I feel it necessary to speak with decision. I declare, then, that no act of mine has given the least colourable cause for the imputation generally understood to be conveyed in that passage; that I never used a single idea derived from the paper in question, or, as far as I am aware, from any work of Professor Christie's; that I never communicated, either to Mr. Weddle, or to any one else, the slightest hint respecting the paper referred to, or even respecting its existence; and that, to the best of my belief, I had never as much as looked at my transcript of that paper, or even thought of it, between the time when it was given me (1837) and the time when Mr. Christie applied to me respecting it (1841). The possession of the paper was only an act of recipiency: it was forced upon me—not sought by myself. The special cause of the Professor's application to me on that occasion, I am not, however, at liberty to state: as my being at that time a member of the Mathematical Committee of the Royal Society, is, I am told, to operate as a seal upon my lips. In short, I am informed, that every communication, whether verbal or written, made to me during the period that I was on that Committee is to be considered as "*private and confidential*"! Need I—can I—add more?

I have the honour to be, Sir,
Your obedient servant,
T. S. DAVIES.

Royal Military Academy, Woolwich,
January 27, 1846.

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*Note.*

We do not exactly know what interpretation to put upon that somewhat obscure passage in the preceding letter which relates to the tardiness of the publication of the paper on "Algebraic Transformation" in the *Mathematician*; but we must say, that a strong impression is made upon our mind by the *Preliminary Note* with which the author of the above letter introduces Mr. Horner's paper to the public. (*Math.* vol. i. p. 108.) We have heard a good deal respecting the *martinet* system which prevails among the professors at Woolwich; a semi-military system, in which the worst features of military etiquette and government are retained, and from which the better and redeeming qualities are totally absent. It struck us, therefore, that from the *generalissimo* of the mathematical forces of the Royal Military Academy, being also the junior secretary of the Royal Society, he might have treated it as "an act of insubordination," for Mr. Davies (himself, an F.R.S.,) to *write* that note, and for his colleagues, Messrs. Rutherford and Fenwick, to *allow* it to be printed. Democracy is a good principle when we can *com-*

*mand* a majority! We know not whether our interpretation be the true one; we merely suggest a possible explanation, and if our surmise be wrong, our pages are open to any other which may be authenticated by the *signatures* of those whose knowledge of the facts entitles them to a hearing.

As that Note contains some truths of which it is of the first importance for young aspirants after scientific honours to be fully cognisant, we annex it here in its entire state. It may console some for the want of such honours; and it may teach all to look upon the possession of them with something less of "wonderment," to know how such honours are gained, and in what cases they are beyond all hope. Science, at all events, is no valid ground of hope—ignorance no ground for despair.—Ed. M. M.

*The Note to the Article on Horner's Algebraic Transformation.*

"No mathematician has contributed so largely as Mr. Horner to the improvement of the problem of the numerical solution of equations; and perhaps no one has left the world with cause so just for considering himself treated with unmerited neglect, and even personal hostility, in connexion with his researches. It is not difficult to account for this, and it reads a lesson to every mathematician; that to obtain the reputation to which his discoveries really entitled him, he must not only make those discoveries, but also, somehow or other, connect himself with a "class," so as to secure an *enforcement* of his claims upon the public mind. A good deal of intrigue and a little science will effect more in the way of cotemporary reputation, than much science, without foreign aid, can ever effect for him. This, indeed, is a melancholy truth: nevertheless, a truth it is.

"Mr. Horner's first paper on equations was printed in the *Philosophical Transactions* for 1819; and Mr. Horner has often stated to me, that much demur was made to the insertion of it in that publication. It was, indeed, owing more to the influence and exertions of Mr. Davies Gilbert, than to any respect to the author, his subject, or his mode of treating it, that the honour was accorded to him. The *elementary character* of the subject was the professed objection: his recondite mode of treating it, was the professed passport for its admission.

"That paper has been reprinted in the *Ladies' Diary* for 1838; and most of our readers are doubtless acquainted with it. That the mode in which it is drawn up is in one respect fortunate, there can be no doubt, since that finally secured its publication; whilst on the other hand, it may be considered unfortunate by its requiring so much higher mathematical learning to understand the reasoning than the nature of the enquiry itself renders desirable. Mr. Horner was himself so sensible of this objection, that he immediately attempted a simplification of the principles. The consequence of this attempt was the papers now about to be submitted to the public for the first time, after lying more than twenty years altogether unknown. The first objection made to it was its *length*: the author curtailed it, under the impression made upon his mind, that it would be printed when so altered: the end of all his labour was,—that it was 'deposited in the archives.'

"That the quality which rendered this paper objectionable in the *Philosophical Transactions* will be a recommendation of it to most of the readers of the *Mathematician*, there can be no doubt: but even as a general method of investigation; as evidences of the high mathematical power of the author; as involving much difficult, delicate and original thinking,—it would not be a discredit, even now, to any author, or to any publication. The paper, indeed, is full of original views; and it will be seen, too, that even after such a lapse of time, every part is instructive."

SOCIETY OF ARTS.

At the meeting of this Society on the 21st inst., (the second ordinary one for the season,) Edward Speer, Esq., in the chair, a very original and interesting paper was read "On the theory of photographic action, illustrating the connexion between the photographic agent

and electricity," by J. Nott, Esq. The following is an abstract of the paper:—

Since the discovery of photography, there is, perhaps, no branch of electrical physics more interesting than that which comprehends the phenomena of phosphorescence. For though light be the apparent agent in the production of the photographic picture; yet the accompanying circumstances can only be satisfactorily explained by a reference to electrical principles.—Light is a term merely relative to us, for light itself has no absolute existence any more than sound: then how unphilosophic are the terms, latent light, and light in darkness, which we sometimes hear, as if that which is merely an effect, could be regarded as a cause, or as a physical force; at the same time that we know it is not possible to demonstrate the existence of any other physical force in nature than electricity.

Light is, therefore, only an attendant circumstance in the production of the photographic picture, and this seems clearly proved by the fact of one body impressing its image upon another in the dark, when the bodies are approximated, to what in electrical phraseology, is called the striking distance.

As light, then, cannot be regarded as the photographic agent, electricity, which in all probability is the principle of light, would seem to be so, and the effects produced when phosphorescence is developed through juxtaposited transparent media, of different densities or electrical affinities, bear so striking an analogy to those which are produced upon a sensitive surface, when exposed to the action of light reflected from bodies in different degrees of intensity, as to render it more than probable that what is understood by the term photography is a simple case of phosphorescence by insulation; for we find that some parts of the sensitive surface then exhibit what may be called an elective affinity for certain substances, while others do not. The results can only be the result of simultaneous attractions and repulsions, the manifestation of which is inconceivable, independent of the presence of electricity.

The question then arises, if the photographic picture be the result of electrical action, why may not the colour as well as the contour of bodies be taken down—seeing that colour is not a property of matter, but is a property of light? All bodies are seen only by reflected light, and their colours vary in tint according to the position of the spectator with respect to the plane of reflection. For instance, in the normal of the plane of reflection, the colour of bodies is most distinct, and at every deviation from this point the local tint changes, and in many cases is totally extinguished when the eye of the spectator reaches the angle of total reflection. Thus, then, where the reflected light is the strongest, the colour of bodies is least perceptible, and *vice versa*.

These considerations induced the writer to try what comparative effect would be produced upon a sensitive surface, by light reflected at various angles of incidence from the plane of the picture. The effects which were thus produced were quite analogous to those which are observed in nature; the local tints of the bodies represented, varying with every change that was made in the angle of reflection, in which the picture was taken down, and the direct ray invariably gave less picturesque results than when a parallel glass was used. In some specimens taken with the parallel glass, when they were looked at directly, all the appearance of a radiating reflection was presented, and when looked at obliquely, all those of a speculary reflection, as if the sun were actually shining within the photographic picture itself.

These results gave promise that some remarkable effects would be produced by polarized light. The writer therefore had a small sun-dial made, the style of which was formed by a bit of very fine silver wire, and from the centre of the dial a bit of the same wire was erected perpendicularly, so that the hour angle and the sun's azimuth were given at the same instant. By means of this instrument he was able to determine with a good deal of accuracy the position of the sun with respect to the plane of the picture that he wished to take a photographic representation of. The glass of the camera was also made adjustible to the polarizing angle by an attached graduated quadrant.

When, by these means, the light was polarized into the camera, by a double reflection from the plane of the picture, and from the parallel glass, he found that the objects in deep shadow, and those in sun-light, were taken down simultaneously, and with equal precision; and

that without the slightest trace of solarization, exhibiting a sunlight view of the greatest truth and beauty, in which the transparency of the shadows, and the effect of the distance produced by an exquisite gradation of tint, such as art could scarcely hope to imitate. The result of polarized light seems doubly interesting since the recent and beautiful discovery of Faraday, where a ray of extinguished polarized light is re-illumed by electricity.

How far this discovery may enable us to determine the nature of the active agent concerned in the production of the photographic picture, the writer would not at the present moment presume to decide, but concluded with submitting a specimen for the inspection of the Society.

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At the same Meeting a paper was read by Mr. H. Page, on a new Patent Oil Integument, or skin of paint, by which great facility is afforded for interior or exterior decoration. The author, after pointing out the various inconveniences which the public experience in having the painting, graining, and oil-decorations done on the premises, proceeded to show some of the advantages which he obtains by substituting a prepared skin of paint for the ordinary common painting. These advantages are very apparent in the decorations of ceilings, or in the execution of any kind of flat ornamental work, whether it be imitations of woods, marbles, lettering in gold or colours, on walls or woodwork, as it is only necessary that the dimensions of the parts to be ornamented should be previously taken, and the work can be completed at the artist's shop, or study. Mr. Page next proceeded to describe the process of manufacture, remarking that the skins at present made are 12ft. by 3ft., that being found the most convenient size; but they can be made of any dimensions. A sheet of fine elephant, or any stout paper, rather larger than the skin required, is taken, and the surface on one side only is prepared with a mixture of gum arabic, treacle, and water, upon which, when dry, a coat of paint, made with boiled oil and white lead, in the ordinary way, is put upon it; when that is dry the operation is repeated till the skin is of the required thickness, but two coats are found to be sufficient for general use. To separate the skin from the paper, it is laid on a clean board with the painted side downwards, the paper is then wetted at the back with clean water, and after it has stood a few minutes the paint may be removed without any difficulty, or the least fear of its tearing. The same paper may be painted on thirty or forty times, but must always be prepared as described above. The paint when removed is carefully wiped with a sponge, and then dried with a wash-leather to remove any portion of the preparation that may adhere to it. The skin is then folded and put away till such time as it may be required for use. The mode of fixing the skin is to rub down the surface to which it is to be attached, and when thoroughly clean, it is gone over with boiled oil and gold-size; a smear is sufficient; the skin is then laid on with a soft cloth, as in the ordinary paper-hanging. Several beautiful specimens were exhibited.

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### THE EXPANSION OF STEAM.—MR. WATT'S CLAIMS.

Sir,—It is not my intention to enter into a discussion of the question raised by S. S., as to the relative claims of Watt and Hornblower to the discovery of the principle of the expansion of steam, because I believe it to have been settled long ago by far abler pens than mine.

I refer those who wish to understand this subject to *Farey*, p. 339 et seq., and particularly to p. 387. To *Lardner*, pp. 157 and 175. *Stuart*, p. 363, vol. ii., and to *Arago's Life of Watt*, p. 88, all of whom are in favour of Watt's claims. I am aware that Tredgold is on the other side, see Part I., p. 28, but he is very concise, and gives no reason for his opinion.

It is matter of history, that, in 1792, Mr. Jonathan Hornblower applied to Parliament for the prolongation of his patent of 1781, that Mr. Watt opposed him, and that his prayer was refused. *Farey*, p. 389. I would suggest for the consideration of my fellow correspondent, S. S., that Mr. Watt's publication of the theory of expansion, was as undoubted as his claim to its discovery, for these reasons :—

1. On the 28th of May, 1769, Watt wrote to Dr. Small, and fully explained the principle of expansion.

2. He practically proved its truth in 1776, by experiments upon the pumping engine at Soho.

3. By the manufacture and sale of the expansion engine for the Shadwell Water Works Company in 1778, he appears to me to have published his discovery in its broadest sense.

Can it be supposed that, under such circumstances, a new principle of so much importance (not inferior to separate condensation) could have been kept a secret, especially when the eyes of the mechanical world were closely watching Watt's proceedings?

The delay in working out this discovery, say, from 1769 to 1778, is fully explained by the difficulties Mr. Watt experienced from the failure of his partner, and in the time subsequently occupied in forming the establishment at Soho.

Is there any parallel between this and the case instanced by S. S.?

I am, Sir, your obt. servant,
PRESSURE NOT PUFF.

London, 27th January, 1846.

## AMERICAN WARLIKE OPERATIONS.

(From the *New York Herald*).

During the last few months a series of experiments have been made with a new invention, originated by Mr. M'Cartey, a gentleman connected with the Navy-yard at Brooklyn. These experiments were ordered by the Government and witnessed by distinguished persons, and were considered by them to be most novel, most original, and most startling, in a naval and military point of view. Commodore Stewart, it will be remembered, spoke of a project by which it would be possible to defend the whole harbour of New York against the combined fleets of all the powers of the world. This may appear to be gasconade, but, from information which has been communicated to us, we are assured that Commodore Stewart's assertion is perfectly correct and literal. The scientific gentleman alluded to, Mr. M'Cartey, who is now connected with the Navy-yard, has invented a new species of artillery, which will discharge 30 balls in a minute, or one every two seconds, for hours together, in succession, and this by mechanical power alone, without gunpowder, chemical substance, or any other preparation. It is effected by merely putting the balls into a hopper and letting the ordnance throw them out with immense *momentum* at the rate of one every two seconds. On one occasion Mr. M'Cartey exhibited the operation of this invention in the Navy-yard before a number of naval officers, who were all astonished by the force and power exhibited, as well as by the great simplicity of the machine. From 12 to 20 pieces of solid timber were united together, forming one compact body. Against this piece of wooden breastwork Mr. M'Cartey opened the battery of this piece of ordnance, and in less than ten minutes the whole solid breastwork was utterly demolished and shivered to splinters by the powerful and rapid succession of discharges upon it. The secret of the invention is known and recorded in history from the time when David went forth with sling and stone to combat the proud Goliah. The principle of this new invention is simply a modification of the principle of the sling, applied to machinery, in connexion with a tube or gun, throwing out a discharge of balls. The machine is so constructed that upon putting in at one end the balls to be discharged, a rotary motion is produced by means of a crank, and, by a few rapid revolutions, each ball receives a force and *momentum equal to that communicated by any quantity of gunpowder.* When this has been done a slide starts and allows each ball to escape in succession from the chamber into a tube, when they are thrown *to almost any distance and with unerring aim.* This ingenious invention, for which a patent has been taken out at Washington, and which ought to be purchased, is worth 500,000 dollars—nay, even millions, to the American Government, in the present crisis of its affairs. By means of such machines, placed in the forts at the Narrows *capable of discharging* any *number of balls of any calibre*, the whole combined fleets of Europe could be torn in pieces and annihilated before they could reach the battery at New York. When we reflect upon the astonishing revolution in the art of war which such a species of ordnance is calculated to produce, and the means of defence which it is capable of supplying, it is to be expected that the President and Congress will take up this matter, and have an armament prepared on this principle, which by its cheapness, its efficiency, and power as a means of defence is beyond all that has ever been conceived or seen in the world hitherto. It is a revolution at once.

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If this were all that Brother Jonathan looks to, to protect him from the indignation of an offended world, we might venture to congratulate the friends of peace and humanity on their having nothing worse to cope with. If manual power only is employed—as the writer evidently wishes the reader to believe—then is the invention referred to utterly worthless, and what is said of it a pack of

nonsense. At the best, it could be but a revival of the long-exploded cross-bow and wheel-lock of olden times. No "David" in all America, or anywhere else, can impart more projective force to a ball, by any sort of machinery whatever, than is in his single man's arm. Machinery may facilitate the application and development of power, but cannot create it. Whether it was by manual power or not, that "the crank," which effected the wonders described, was moved, the writer is careful to leave in obscurity. If it was moved by no human arm, but by some powerful steam engine—say one of a hundred or two hundred horses power—then there is an end of all wonder, and all novelty too. The "scientific" M'Cartey, supposing him to have done all that we are told he did, (which we greatly doubt,) has done no more than Perkins did many years ago in this country, or at least showed can be done; and that was a vast deal less than can be accomplished by an equal amount of money expended on good guns, good powder, and good shot.—Ed. M. M.

THE NEW AMERICAN PROJECTILE—ENGLISH CLAIMANT TO THE INVENTION.

Sir,—I beg to call your attention to a paragraph in yesterday's *Times*, quoted from the *New York Herald*.* You will there see a plan patronized by the Government of the United States exactly similar in principle to the one I brought under your consideration near twelve months ago, and which you considered could not be carried out; but it now appears brother Jonathan is of a different opinion. However, as I was influenced by your judgment, and also by the consideration that the idea was of a destructive instead of a useful tendency, I have not proceeded further with it. But as it is now made public, I may add that it appeared to me to be most available on board of men of war steamers, as they would always have (at no additional cost) an immense power ready at any moment to be applied to a projectile apparatus; and further, that if required in the bombardment of a seaport, the vessel might in a dark night take up a position, and pour on the devoted town a stream of destructive missiles without running the slightest risk of reprisals, as there being no noise or light produced in the process of projecting, her own position could not be made out.

I remain, Sir,

Yours faithfully,

WILLIAM WOOD.

36, Dean-Street, Soho. January 27, 1846.

* See preceding article.

THE CREOSOTE MEAT SAFE.

Creosote, so named from its great antiseptic power, which exceeds, perhaps, that of any other substance, has been long employed to preserve animal matters from decay. The only two ways in which creosote is usually applied for this purpose, consist either in exposing the meat which we wish to preserve to the smoke of the burning wood, of which creosote is the effective constituent, or else in immersing it for a short time in water containing a few drops of creosote. Articles of food prepared by either of these methods may, as is well known, be kept for a long time without spoiling; but both these modes of using the creosote are attended with the inconvenience that the food necessarily acquires the taste and smell peculiar to smoked meat, which is by no means agreeable to every one. By the method now proposed, this inconvenience is entirely avoided.

During the past summer, (1842,) which was so unusually hot, in common with most persons I experienced considerable difficulty in preserving fresh meat even for a few days. It struck me at length, however, that perhaps the vapours of creosote might be found useful for this purpose, and the method adopted was the following very simple one: I placed a small plate containing a little creosote immediately under each piece of meat as it hung suspended in the larder, and covered both over with a cloth. The creosote soon gave off vapours which formed an antiseptic atmosphere around the meat, and kept it quite fresh three or four days longer than it would otherwise have been.

If the plate is gently heated before the creosote is put into it, the vapours rise more quickly, and if the additional precaution is also taken of suspending the meat in a wooden box or earthen jar which can be closed with a lid, the beneficial effect is still more discernible. I have tried this process during the greater part of last summer with invariable success, and, a butcher, who also tried it on a larger scale in his stall, was equally convinced of its efficacy. The meat, when cooked, has not the slightest smell or taste of creosote.

There is also another advantage attending the use of the creosote. Its smell is so disagreeable to flies that it effectually frees a larder from the presence of these noxious insects. The same quantity of creosote

may be used for several weeks, but on being long exposed to the air it loses most of its smell, and is partly changed into a species of resin.

Creosote is not a simple proximate principle, as has been supposed, but consists of a mixture of empyreumatic oils, having different boiling points, and containing quantities of carbon, which, from some experiments which I have made, vary so much as from three to four per cent.—*Dr. Stenhouse, Proc. Glasg. Phil. Soc.*

### THE SUGAR MANUFACTURE — CROSLEY'S ATMOSPHERIC PROCESS.

Sir,—In your last Number of the 24th instant, you have obligingly inserted the letter I addressed to you relative to the use of atmospheric air in the manufacture of sugar. By the words, "*certain publications which are in private circulation*," I alluded particularly to one of a Mr. H. Robinson, and *not* at all to the circular of Messrs. P. and W. M'Onie, who have honourably transmitted to me a satisfactory explanation, so far as their circular is concerned, which explanation is printed with the testimonials I submitted to you.

I remain, Sir, your obedient servant,
H. CROSLEY.

Emerson-street, Southwark, Jan. 26, 1846.

### THE "METEOR" STEAMER.

Sir,—In looking over some of your back Numbers I have been led to reconsider the discussion between Mr. Cormack and myself as to whether the *Meteor* was slighter or stronger than the other boats with which she was then competing. This calmer consideration has convinced me that I was not quite justified in the course which I then pursued.

I would wish it to be distinctly understood, in case it should not be sufficiently clear from former letters, that my opinion was not founded upon personal observation beyond what could be gathered from inspecting the outside of the vessel without taking measurements; and that for the nature of the internal work I relied upon the evidence of others. Now I feel that although the evidence of independent persons skilled in the subject, combined with what appeared to me the absurdity of Mr. Cormack's statement, and his inconsistency in refusing to bring forward the information which he had promised, might be sufficient to convince myself, I was wrong to maintain my opinion publicly in opposition to one who professed to have had greater opportunities of personal inspection, and to be in possession of the details of her scantling: I therefore apologize to Mr. Cormack, yourself, and your readers, for having done so, and regret exceedingly that my letters on the subject cannot now be cancelled.

It is possible that what I took for a promise may not have been intended as such, in which case Mr. Cormack would be free from the charge of inconsistency.

I remain, Sir, your obedient servant,
CURVE.

### LIST OF NEW STEAM VESSELS IN THE PROGRESS OF CONSTRUCTION FOR THE BRITISH GOVERNMENT, WITH THEIR POWER, AND THE NAMES OF THE ENGINE-MAKERS.

| Name of vessel. | Horse-power. | Engineers. |
|---|---|---|
| Terrible | 800 | |
| Guardship | 450 | |
| Guardship | 450 | |
| Niger | 400 | Messrs. Maudslay and Field. |
| Conflict | 400 | |
| Medea | 350 | |
| Grappler | 220 | |
| Total horse pr. | 3070 | |
| Avenger | 650 | |
| Sidon | 600 | |
| Termagant | 620 | Messrs. Seaward and Capel. |
| Guardship | 450 | |
| Guardship | 450 | |
| Desperate | 400 | |
| Torch | 150 | |
| Total horse pr. | 3320 | |
| Gladiator | 430 | |
| Amphion | 300 | |
| Triton | 264 | |
| Rifleman | 202 | Messrs. Miller, Ravenhill, and Co. |
| Sharpshooter | 202 | |
| Minx | 100 | |
| Teazer | 100 | |
| Total horse pr. | 1598 | |
| Vulcan | 700 | |
| Centaur | 540 | |
| Trident | 350 | Messrs. Boulton & Watt. |
| Guardship | 350 | |
| Guardship | 350 | |
| Myrmidon | 150 | |
| Total | 2440 | |
| Bull Dog | 500 | |
| Guardship | 350 | |
| Guardship | 350 | Messrs. Rennie. |
| Oberon | 260 | |
| Total | 1460 | |

| | | |
|---|---|---|
| Dragon | 560 | Messrs. Fairbairn and Co. |
| Odin | 556 | |
| Megæra | 520 | |
| Total | 1636 | |
| Sphynx | 500 | Messrs. Penn & Co. |
| Encounter | 360 | |
| Antelope | 260 | |
| Harpy | 200 | |
| Garland | 120 | |
| Total | 1440 | |
| Simoom | 780 | Messrs. Napier and Co. |
| Dauntless | 580 | |
| Total | 1360 | |
| Inflexible | 350 | Messrs. Fawcett & Co. |
| Birkenhead | 556 | " Forrester & Co. |
| Fury | 515 | Messrs. Rigby & Co. |
| Janus | 220 | " Robinson and Co. |
| Pegasus | 510 | " Scott & Sinclair. |

SUMMARY.

| | H. power. |
|---|---|
| Seaward and Capel | 3320 |
| Maudslay and Field | 3070 |
| Boulton and Watt | 2440 |
| Fairbairn and Co. | 1636 |
| Miller and Ravenhill | 1598 |
| Rennie and Co. | 1460 |
| Penn and Co. | 1440 |
| Napier and Co | 1360 |
| Forrester and Co. | 556 |
| Rigby and Co. | 515 |
| Scott and Sinclair | 510 |
| Fawcett and Co. | 350 |
| Robinson and Co. | 220 |
| Total horse power | 18,475 |

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65, FROM DECEMBER 26, TO JANUARY 27, 1846.

| Date of Registration. | No. in the Register. | Proprietors' Names. | Address. | Subject of Design. |
|---|---|---|---|---|
| Dec. 26 | 613 | James Gisborne | Suffolk-street, Birmingham | Improved windways and valves for cornopeans and other valved instruments. |
| 30 | 614 | Samuel Messenger | Birmingham | Improved railway lamp. |
| 31 | 615 | William Goddard | Nottingham | Knitted shirt or vest. |
| 1846 Jan. 1 | 616 | Berens, Blumberg, and Co. | 33, St. Paul's Churchyard, London | Instrument for holding up ladies' dresses. |
| 2 | 617 | Ebenezer Taylor and Son | 25, Bartlett's buildings, Holborn, London | Watch protector. |
| ,, | 618 | Maria Connor | 2, Cambridge-terrace, Dacre-park, Blackheath | Knife and fork cleaner. |
| ,, | 619 | John Baldwin Wheeler and John Lee Ablett | 23, Poultry / 234, Regent street, London | Stiffener. |
| 5 | 620 | George Prudden | Hitchin, Hertfordshire | Holdwater stove. |
| ,, | 621 | George Blackmur | York-street, Commercial-road | Princess Royal parasol and umbrella tube. |
| 6 | 622 | John Scholl | 41, Berwick-street, Oxford-street | Bow drill. |
| ,, | 623 | Joseph P. Vates | Sutton Coldfield, near Birmingham | Equilateral valve and improved tuning slide for the tromba, cornuta cornopean, and other valve instruments. |
| 8 | 624 | E. L. Simmons | 21, Coleman-street, City of London | Portable hygrometer. |
| 9 | 625 | George Mauder | 25, Old Compton-street, Soho, London | Folding level staff. |
| 10 | 626 | Ann Lawson Ollivier | 54, Pall Mall | The cordon retrousseur. |
| 12 | 627 | Hugh Strath | Brownlow Mews, Gray's Inn-road | Chimney cowl or guard. |
| 14 | 628 | William Goddard | Nottingham | Knitted shirt or vest. |
| 15 | 629 | Henry Powell | 102, New Bond-street, Parish of St. George, Middlesex | The comprimo brace. |
| 17 | 630 | Thomas Watkins and Son | 1 & 2, Cannon-street, London | Quill pen protecting cover. |
| 20 | 631 | Abraham Thompson | Willenhall, Staffordshire | Padlock. |
| 21 | 632 | George Smith | Conduit-street | Victoria toilet. |
| 23 | 633 | Edward Walmsley | 138, Union-street, Southwark | Ventilating hat. |
| ,, | 634 | George Farrow | Park Lodge, Peckham, Surrey | Knife and fork cleaner. |
| 26 | 635 | William and George Ashford | Birmingham | Bit. |
| ,, | 636 | Edward Cahan | 371, Strand | The omnium. |
| 27 | 637 | Capt. Thomas St. Vincent Troubridge, of Her Majesty's 7th Royal Fusilier Guards | 11, Eaton-place, Belgrave-square | Design for carrying knapsacks and valises. |
| ,, | 638 | James Hayes | Elton, Huntingdonshire | Straw shaking machine, applicable to thrashing machines. |

John Dearman Dunnicliff, of Nottingham, lace-manufacturer, and William Bull Dexter, of the same place, lacemaker, for improvements in the manufacture of warp fabrics. December 24; six months.

Charles William Siemans, Finsbury, Middlesex, engineer, for improvements in steam-engines, and improvements in regulating the power and velocity of machines for communicating power. December 24; six months.

Daniel Towers Shears, of Bankside, Southwark, for improvements in the treatment of zink ingots, which improvements are applicable to the reduction of other ores and metals. December 24; six months.

Wilton George Turner, of Gateshead, Durham, Doctor in Philosophy, for an improved mode of treating guano, for the purpose of obtaining chemical compounds therefrom. December 24; six months.

Henry Pershouse, of Birmingham, manufacturer, for a certain improvement, or improvements, in apparatus used in connexion with writing, and also in attaching postage stamps and labels. December 25; six months.

John Penn, of Greenwich, engineer and manufacturer of steam-engines, William Hartree, the younger, and John Matthew, of Greenwich, engineers, for the invention of certain improvements in steam engines and machinery for propelling vessels, which improvements are also applicable for other purposes. December 25; six months.

William Cole, of Coventry, Warwick, warehouseman, for certain improvements in looms. December 25; six months.

John Russell, of Edinburgh, accountant, for manufacture of glass tiles. December 30; six months.

Thomas Swinburne, of Lincoln's-inn, Esq., for improvements in railways, and in the means of propelling and carrying thereon. January 3, six months.

Arthur Eldred Walker, of Bouverie-street, London, engraver, for certain improvements in machinery for sowing. January 6; six months.

Conrad Haverkam Greenhow, of North Shields, gent., for improvements in the construction of railways and railway carriages. January 6; six months.

Henry Watson, of Newcastle-upon-Tyne, brass-founder, for improvements in withdrawing air and vapours from furnaces or other apparatus, and in condensing and employing such vapours. January 6; six months.

Joseph Romnald Bozek, of Cheapside, mechanic, for improvements in the construction and application of railway-carriage wheels. January 6; six months.

William Smith Brown, the younger, of Broad-street, Ratcliff-cross, sail-maker, for improvements in the manufacture of square and quadrilateral sails for ships and other vessels. January 6; six months.

Joseph Douglas, of Cross-cheaping, Coventry, furnishing ironmonger, for improvements in the patterns used for casting, and in casting metals. January 9; six months.

Charles Chinnock, of Cook's-grounds, Chelsea, for improvements in the construction and methods of extending and compressing articles of furniture and domestic use, also applicable to cutlery, workmen's tools, windows, blinds, shutters, and similar useful purposes. January 12; six months.

Charles Hancock, of Grosvenor-place, gent., for certain improvements in the manufacture of gutta percha, and its applications alone, and in combination with other substances. January 12; six months.

Henry Schloss, of Finsbury-square, gent., for an improved instrument or instruments for producing ignition. January 12; six months.

John Seaward, of the Canal Iron Works, engineer, for improvements in the steam engine, and in machinery for propelling. January 12; six months.

George Tillett, of Snow-hill, ironmonger for improvements in stoves and fire-places. January 13; six months.

Jean Marie Durnerin, of Paris, doctor of medicine, for improvements in treating fatty matters. January 13; six months.

Thomas Moorcroft Benbow, of Birmingham, surgeon, for improvements in fastenings for surgical and other bandages, and for articles of dress. January 13; six months.

Robert Bewick Longridge, of the Bedlington Iron Works, near Morpeth, Northumberland, for an improved locomotive engine. January 13; six months.

Joseph Maudslay, of the firm of Maudslay and Field, of Lambeth, engineers, for improvements in propelling and propelling machinery. January 13; six months.

Edmund Leahy, of Cork, Ireland, civil engineer, for certain improvements in locomotive carriages intended to be employed on ordinary roads. January 15; six months.

William Benson, of Allerwash House, Haydonbridge, Northumberland, gent., for certain improvements in machines for the manufacture of tiles and other plastic substances. January 15; six months.

William Clarke, of Nottingham, and William Vickers, the younger, of the same place, lace manufacturers, for improvements in manufacturing lace and other fabrics by lace machinery. January 17, six months.

Arthur Wellington Price, of Manchester-street, Gray's-inn-road, gent., for improvements in the construction of anchors. January 17; six months.

Peter Taylor, of Hollingwood, near Manchester, machinist, for certain improvements in machinery, for propelling vessels, carriages, and machinery parts of which improvements are applicable to drawing and propelling fluids; also improvements in the construction of vessels. January 20; six months.

Gerard Andrew Arney, of Mare-street, Hackney, gent., for improvements in the preparation of gelatine, and improvements in fining or clarifying liquids. January 20; six months.

John Braithwaite, of Bedford-square, civil Engineer, for certain improvements in heating, lighting, and ventilating. January 20; six months.

William Vincent Wennington, of Goscote Iron Works, Stafford, esq., for certain improvements in or improved methods of cutting plate and sheet iron. January 20; six months.

Richard Archibald Brooman, of Fleet-street, London, gent., for certain improvements in Railway and common road carriages. (Being a communication.) January 20; six months.

William Malins, of Mansion-House-Place, London, and West-Bromwich, Stafford, iron master, for certain improvements in the construction of buildings. (Being a communication.) January 20; six months.

William Newton, of Chancery-lane, Middlesex, civil engineer, for certain improvements in manufacturing piled fabrics. (Being a communication.) January 20; six months.

John Nott, of Cork, gent., for certain improvements in the means of communicating intelligence from one place to another. January 20; six months.

Andrew Kurts, of St. Helen's, Lancashire, manufacturing chemist, for certain improvements in the construction of furnaces and apparatus connected therewith, for evaporating or concentrating sulphuric acid. January 20; six months.

John Spenceley, of Whitstable, Kent, master block-maker, for improvements in the construction of ships and other vessels, and also improvements in apparatus to be attached to ships and other vessels. January 20; six months.

John Walker, of Manchester, silk-manufacturer, for certain improvements in weaving or manufacturing piled or napped cloths or fabrics, and also improvements in machinery or apparatus for cut-

ting the pile or nap of the same. January 20; six months.

William Henry Burkee, of Tottenham, gentleman, for certain improvements in the manufacture of fabrics, which may, if required, be made air and waterproof, a part of the materials employed herein, when combined with other matters, being intended to produce coverings for vessels of capacity. January 20; six months.

Charles Wheeler, of Speenhamlane, Berkshire, machinist, for certain improvements in the construction and working of railways. January 22; six months.

Joseph Cooper, of Great Chart-street, Hoxton, chemist, for an improved mode of separating certain of the fluid and soluble parts of certain vegetable substances from the solid parts thereof. January 22; six months.

Frederick William Campin, of Fleet-street, London, gentleman, for certain improvements in obtaining and applying motive power. January 22; six months.

Daniel Ross, of South-street, Southwark, hat-manufacturer, for improvements in the manufacture of hats. January 27; six months.

George Frederick Hall, of Norfolk-street, Middlesex, pawnbroker, for certain machinery, or apparatus, for writing and booking, numbering, cutting, checking, and expediting the delivery and receipt of pawnbrokers' duplicates, pass tickets, and other like documents. January 29; six months.

## LIST OF PATENTS GRANTED FOR SCOTLAND FROM THE 22ND OF DECEMBER, 1845, TO THE 22ND OF JANUARY, 1846.

John Field, jun., of West Brixton, Surrey, gent., for improvements in ascertaining the alcoholic strength of liquids. (Being a communication from abroad.) Sealed, December 26.

Henry Watson, brass-founder, of Newcastle-upon-Tyne, for improvements in withdrawing air and vapours from furnaces, or other apparatus, and in condensing and employing such vapours. Dec. 26.

Alfred Vincent Newton, 66, Chancery-lane, Middlesex, mechanical draughtsman, for improvements in printing and dyeing various fabrics. (Being a communication from abroad.) January 6.

James Augustus Dorr, of New York, America, gent., for certain imgrovements in machinery or apparatus for knitting. (Being a communication from abroad. January 6.

William Smith Brown, the Younger, of Broad-street, Ratcliffe-cross, Middlesex, sail-maker, for improvements in the manufacture of square and quadrilateral sails for ships and other vessels. January 7.

Joseph Douglas, of Cross cheaping, Coventry, furnishing ironmonger, for improvements in the patterns used for casting metals. January 7.

James Garforth, of Duckinfield, Chester, engineer, for certain improvements in machinery, or apparatus for connecting metallic plates for the construction of boilers and other purposes. January 7.

Alfred Vincent Newton, 66, Chancery-lane, Middlesex, mechanical draughtsman, for improvements in combing wool. (Being a communication from abroad.) January 9.

Conrad Haverkam Greenhow, of North Shields, for improvements in the construction of railways and railway carriages. January 19.

Charles Henry Joseph Forret, of Lille, France, but now of 17, Great Saint Helen's, Bishopgate, gentleman, for a new and improved Archimedean screw, which he calls Davaine's screw. (Being a communication from abroad.) January 21.

Charles Dowse, of Camden Town, Middlesex, for an improved paper or material. January 22.

Robert Rettie, civil engineer, Glasgow, Lanark, for an improved method of signalizing, or telegraphing on sea or land, preventing collision, and giving signals of distress by improved burners and glasses, coloured, or otherwise, applicable to railways in all the various departments, as well as preventing of accidents when the train is at full speed, showing the state of the tide, in harbours at night or day, also the diurnal for railways, towns and villages. January 22.

John Pattrinari, 1, Skinner's-place, Size-lane, gent., for certain new and improved modes of obtaining and applying motive power. January 22.

George Howell, of Larkhall-lane, Clapham, Surrey, gent., for an invention for coating with metal the surface of articles formed of copper, or copper alloys, or iron, wrought or cast. (Being a communication from abroad.) January 22.

## NOTES AND NOTICES.

*Tunnel between Dover and Calais.*—Messrs. Franchut and Du Motay propose, instead of preparing for war with this country, to abridge the time of friendly communication between Dover and Calais, and thus rescue the British isles from their present condition of land isolation from the Continent. They propose to accomplish this more peaceful object by a tunnel, to be composed of a series of iron tubes, of about 4 metres long, with a diameter of 2½. The works being commenced simultaneously on the two opposite coasts, when the tubes reach the water, other tubes are to be successively let down from a vessel placed over the boundary of the last tube, the orifice of this tube being closed by a disk in wood. The descending tube is to be suspended from a crane by a cord, which attaches itself, on coming in contact, to a sort of wheel fixed in the tube below, and the two having been before adjusted to each other, the locks or springs with which they are provided serve to bolt them together water-tight, and then the wooden disk of the one is carried forward to close up the end of the other. It is evidently assumed by the hardy projectors that the channel sea rolls over a perfectly level plain. But how if there should be found—as assuredly there would be—something like the same undulations and varieties of surface, even to steep hills and deep valleys, as on dry land? How is the line of tubes to be supported midway in the water sometimes; and how can the tubes be maintained water-tight, with mere bolts, locks, or fittings in? The scheme is noticed for its extravagant novelty.—*Daily News.*—[The plan of Messrs. Franchut and Du Motay is only a revival of one proposed some time ago by Mr. De la Haye of Liverpool, and fully described in our Journal, vol. xliii. p. 162.—Ed. M.M.]

*The "Man-Machine."*—At the last meeting of the Royal Cornwall Polytechnic Society a description, by Capt. W. Francis, was read of a man-machine, which has been recently erected at the United Mines, Gwennap. To the adventurers in these mines has been awarded the second premium (100*l.*) subscribed for the purpose of encouraging the introduction of machinery for facilitating the ascent and descent of the miner in the deep mines of Cornwall. The first premium (500*l.*) was paid about three years since to Tresavean Mine. Now that the utility of the man-machine, not only to the miner but in a pecuniary view to the adventurers also, has been so fully established, it is hoped that it will be speedily introduced into all the deep mines in the kingdom.

*Steam Engine-making in France.*—The *Moniteur Industriel* makes the following remarks on the subject:—"We have again lost another steam-vessel, the *Papin*. It is but a few days ago we lost the *Serpent*, the *Sphinx*, and the *Groveniand*. To what are we to attribute these great losses? They have accused our naval officers wrongfully. But, it is possible, that the men who are entrusted with the care of looking after these steam-engines on board those vessels, had not been sufficiently instructed, as it is impossible to study the naval steam-engines otherwise than where they are made. In France, up to the present day, instead of doing all we possi-

bly can, we have done all that is possible to import them from England. This is not all; it appears that the boilers of the *Papin*, of which the steam-engine was English, had been made at Indret, and that it was only in consequence of the defectiveness of these boilers that the vessel was lost" The *Constitutionnel* adds to the above the following observations:—"We are confidently informed that the boilers of the *Papin* were manufactured at Indret; that they were a great deal too inefficient in power and dimension, and also too small for the vessel they were destined for, and that they were not able to supply a sufficient steam-power to resist the fall of wind which drove the vessel on the coast. This is not the first time that the weakness and defective construction of the machines that have been sent out from the workshops of Indret have been manifested. We have seen the *Cacique* steam frigate, with a steam-engine of 450 horses power made from this factory, trying in vain to get out of the river Loire. The *Compte d'Eu* steamer, which was intended as a private yacht for the use of his Majesty Louis Philippe, could not be available in consequence of the defective state of its machinery and build, as it was considered quite insecure."

*The Terrible War Steamer.*—The Terrible war steamer is in commission, and now fitting for sea at Woolwich; she has 20 guns mounted. On her upper deck, each side the bow, are two long 56-pounders, Monk's 11-feet guns, to fire fore and aft in a line with the keel; these are mounted on a slide, and will cross fire with each other, and, also sweep round to the sides; two more of the same guns, right aft in the stern, will also cross and sweep to the broadside on their pivot, so as to fire forward, acting as chase guns if required. She has two 68-pounders on each broadside, to carry shells or solid shot, which can be trained fore or abaft, according to circumstances. On the deck below, which is also flush fore and aft, are eight guns, viz., two long 56-pounders, Monk's guns, 11 feet long, in the bow ports, to fire in a line with the keel, and also several degrees of training on the broadsides and two of the same guns in the stern, right aft, which can give such depression as to prevent even a small boat from coming under her stern; with four guns, 68 pounders, on her broadsides, for shells or solid shot. There are four smaller guns on the upper deck, to be traversed to any place or carried on shore in her paddle-box boats, if required for use in landing troops, &c. She has four separate boilers, independent of each other, which may be connected when required; four funnels, one to each boiler; the two after ones strike down, so as to allow a square mainsail to be set when sailing, and still using the two foremost boilers, thus working half her power, at the same time saving a considerable consumption of coals. As there are four small funnels, instead of one large one, this is a great advantage, as the ship will not be wholly disabled by losing one two, or even three funnels. The Terrible has two magazines, and two shell-rooms, one of each before the engine-room, and one abaft for the safety of the vessel, to prevent any powder passing the engine-rooms when firing the guns. She can store 400 tons of coals below the lower deck, and is prepared on the midship part of the deck to take 200 or 300 tons more, packed in bags, as a defence from shot to the engines and boilers, filling up a space of 18ft. In addition to her thick, substantial, solid sides, she has good capacity, and, if required for any particular service, can carry more coal in sacks. With regard to the conveyance of troops, she can berth 1,000 men under cover on her second gun-deck, independent of her ship's company, their berth being below forward, and the officers' cabins, gun-room, &c., abaft; so that each gundeck is entirely clear and always ready for action, without removing a bulkhead, and the deck being perfectly free from the captain's cabin abaft, to the bow of the vessel. She is constructed in the strongest and most substantial manner, on Mr. Lang's improved method of uniting the frame timbers, making her perfectly water-tight, so that she would swim even if her external keel and plank were off her bottom. This method is also adopted in the *Royal Albert*, 120 guns, now in her frame, and may be seen in the slip in Woolwich dockyard. The engine-room of the *Terrible* is most splendid; on deck, the whole length of the engine-room, are gratings open and well ventilated by hatchways, giving light and air to the engineers, stokers, &c. It is an admirable plan, such as no steamer as yet has the advantage of; and each boiler has a separate hatchway, through which it may be readily taken out for repair, without interfering with the other boilers. The *Terrible's* engines are most majestic; they are 800 horses power, the production of Messrs. Maudslay, Sons, and Field, and show to advantage in this large war-steamer. Her decks have hatchways in various parts, scuttles, skylights, &c., for ventilating the ship even to the lower parts of her hull; and there are many other conveniences, too numerous to mention, contributing to the efficiency of the ship, and the comforts of the officers and crew, so that she may be said to be the largest and most perfect war steamer ever built.—*Nautical Standard.*

*Engraving on Glass.*—We have lately had an opportunity of inspecting some beautiful specimens of printing from designs engraved, or rather etched upon glass; the process is invented by a German, and the specimens far exceed in beauty and clearness any of the kind that we have ever before seen. It is well known that by exposure to certain chemical agency the surface of glass becomes absorbed or eaten away, so that it is rendered uneven, and of the character and appearance of ground glass, Glass is a substance formed by the chemical union of several materials, such as oxide of lead, silica or flint, and an alkali, as potash or soda: as a chemical compound, glass is exceedingly persistent, not being liable, when well made, to undergo change by exposure to the air, heat, or any ordinary chemical agent, however powerful; the strongest mineral acids produce no effect upon it, neither do the alkalies, particularly when it is made without lead; almost the only chemical substance capable of affecting it is the element fluorine, under the form of hydrofluoric acid. When glass is exposed to the action of this agent, it is speedily dissolved, owing to the destruction of its chemical character as glass, and the formation of a new substance by the union of the fluorine with its elements. This action may be stopped at pleasure, so that the glass may be either extremely affected only, or otherwise entirely dissolved. The process employed in the etching is as follows:—The plate glass is covered with a very thin coating of bitumen and wax, a coating of sufficient thickness only to be continuous upon the surface of the plate; through this the design is traced with a sharp steel needle, and etched as in ordinary etching; the plate is then subjected to the action of the solvent, the effect of which may be regulated to a nicety; when this action has continued sufficiently long for the delicate parts, they are stopped out, and the stronger lines further bitten, until the effect is complete. The glass plate is then rendered thicker by plaster of Paris, so as to resist the pressure in printing. The great advantage of this process is in the solvent employed; this is as yet kept secret by the inventor, but it will, we believe, be shortly given to the world. The engravings by this process possess extraordinary sharpness and delicacy, and the plates do not wear like copper or steel.—*The Art Union.*

*Errata in Captain Hoseason's paper.*—Page 56, col. 1., line 20, for "deducted" read "deduced." Page 57, col. 1, line 17, for "tend" read "send." Same page and col., line 17 from the bottom, after "horse-power" read, "and the screw has been applied to her."

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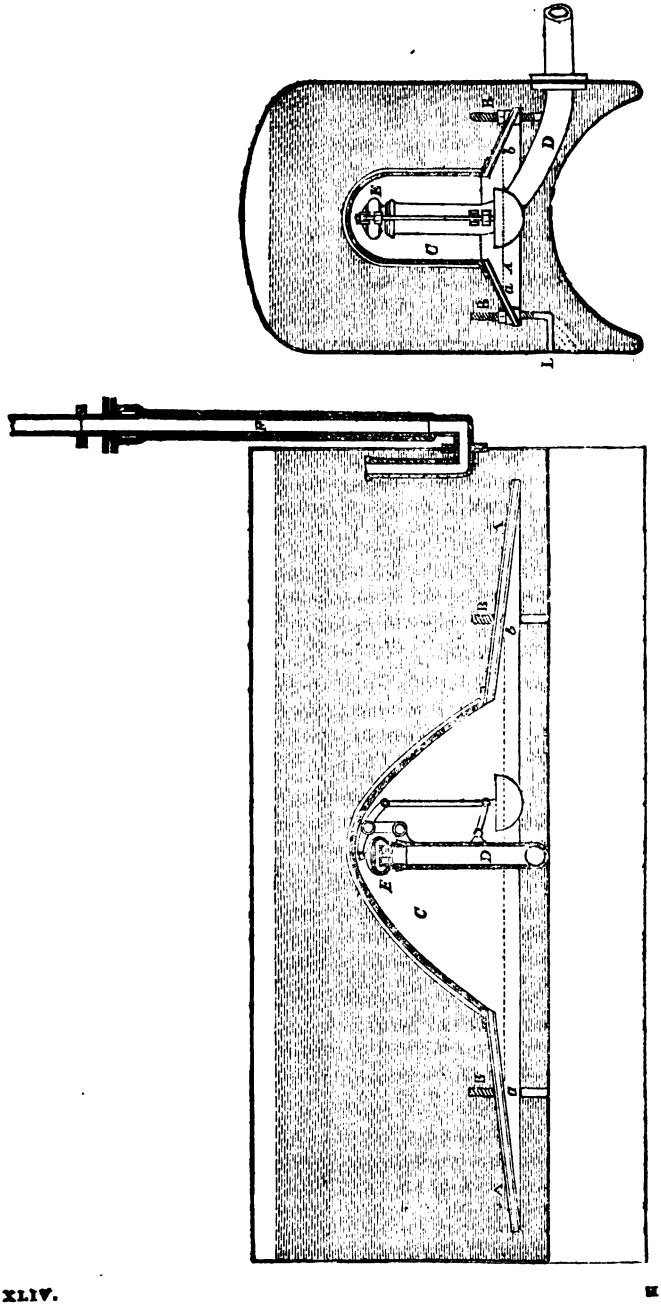
MEADE'S PATENT HYDROSTATIC BOILER.



## MEADE'S PATENT HYDROSTATIC BOILER.

[Patent dated July 12, 1845; Specification enrolled, January 12, 1846.]

THE nature and amount of the advantages possessed by this construction of boiler will be readily understood from a consideration of the following particulars:

There is in every boiler a certain amount of internal expansion of steam, and consequent expenditure of power, the existence of which appears to have been practically overlooked, but which will be found, on examination, to absorb a very large proportion of the power originally generated. This continuous expansion of steam *in the boiler*, between its point of generation at an extreme temperature, and consequently, maximum elasticity, and its influx into the steam-chest, is, in its nature, precisely analogous to that which takes place *in the cylinder* between its admission at a higher and its discharge at a lower degree of elasticity. A certain amount of this expenditure in mere self-diffusion through the water is inevitable; but to limit its extent, and so far augment the power of the steam admitted to the engine, is practicable; and to effect this without increase of strain upon the boiler is one of the objects of the construction now patented, which, from the nature of its action, is termed the "hydrostatic." The lower parts of a boiler, it is to be borne in mind, always sustain a pressure greater than that upon the upper, by the additional weight of water which bears upon them; and as this is equal to 62½ lbs. for every cubic foot, the amount of extreme difference in a boiler of average dimensions will be equivalent to many tons. This pressure, which is now inoperative for any useful purpose, is here in great part applied to limit the internal expansion, and thus ensure a proportionally higher elasticity of steam, without in any degree adding to the disruptive force upon the boiler. Two objects then are, to reduce the amount of expansion *in the boiler*, and thus increase to an equal extent the utility of the steam *in the engine*, and at the same time, to accomplish this on the low pressure system, or without augmenting the existing force of distension. They are thus simultaneously effected. The steam collector, instead of being placed, as is usual, at that part of the boiler which is most remote from the surface of generation—thus rendering the amount of internal expenditure a maximum—is transferred to as close a proximity to the fire surface as is compatible with an intermediate body of water sufficient for the absorption of the heat. By this arrangement, as will appear from inspection of the engraving, the steam, in common with the lower parts of the boiler, is at the same time subjected to the weight of the superincumbent water, and thus compelled to retain a proportionally greater amount of its original elastic force. The additional power thus secured for useful operation in the engine, by the transposition or submersion of the steam collector as described, will be equal, in boilers of the usual proportion, to from 2 to 3 lbs. upon the square inch, or to several tons upon a piston of average area; while the internal pressure they sustain still remains unaltered in amount.

Another advantage possessed by this form of structure is the large proportion which the fire surface bears to the body of water to be evaporated. Upon examination of the subject, it will appear that the superiority of tubular boilers for power and rapidity of generation, depends, not merely on the absolute increase of fire surface, and consequently, more complete transmission of the heat produced, but, much more on its relative increase to the quantity of water to be evaporated. Equal amounts of fuel will, it is considered, whether high or low pressure action be adopted, generate equal amounts of power, but the quantity of water will regulate the proportion absorbed in internal diffusion—that is, the *useful* effect of the steam produced would appear to be *directly* as the heat communicated and *inversely* as the bulk of water to which it is imparted. As the hydrostatic boiler can fulfil to the highest degree this latter condition of utility, its efficiency in this respect, will, it is submitted, be found fully equal to that of the best tubular one, without its costliness and complexity, while the benefit resulting from the hydrostatic action of the contained water will still remain peculiar to it.

The mode of action will be apparent from the engravings. A A, &c., is the submerged collector, its position being adjustable by the screws, B B. Between it and the bottom of the boiler a water-space of, say from 4 to 6 inches, is provided;

and between it and the sides there is also an interval of a few inches for the circulation of the water. At the same distance below the oblique ledge, L, deflects the steam generated by the side-flue, or at the bottom, so as to bring it under the collector. The steam in its ascent being collected, thus passes to the steam-dome, C, from which it is conveyed to the engine by the pipe, D. The float and valve, E, regulate the admission of the steam into the pipe; and as it only opens when the water line is depressed by the accumulating steam to the line, *a b*, it always ensures a sufficient supply of dry steam for the use of the engine. Should the production of steam exceed the consumption of the engine, it will gradually depress the surface of the water under the collector till it reaches the verge or lip of the latter, and then escape into the cooler water above. If this should be raised to a state of ebullition by the steam which thus escapes, no inconvenience can accrue, as any excess of steam thus produced may, when necessary, be discharged at any definite pressure by a safety valve at the top; its elasticity, however, being still inferior to that of the steam used by the engine in proportion to the weight of the column of water sustained by the latter. The recurved pipe, F, may also, where circumstances conveniently admit, be used to serve the purpose of the ordinary safety valve without its liability to derangement. If furnished with a telescope joint it can readily be adjusted to any height; and precisely in proportion to the elevation at which the water is made to stand in it will be the specific elasticity of the steam in the collector. The recurved form will retard the escape of vapour by reason of the slow descent of heat; or when this regulator is employed, the feed may be introduced in connexion with it. The collector, (which, being subject to nearly equal pressure above and below, is of light structure,) is made non-conducting, and also removable on occasion for cleansing or other purposes. The flue may be arranged as in the ordinary wagon boiler, or according to any other approved method.

It is here supposed that the dimensions of the boiler are upon the usual scale; but in their construction I consider it advantageous to reduce the depth of the upper compartment, as economising space and material, and to provide for the desired pressure on the steam by the recurved pipe, or more conveniently by the elastic force of steam itself upon the water in the upper compartment. A considerable body of water, however, above the collector, will prove most serviceable as a receptacle for surplus heat and steam, and as a convenient reservoir for the regular supply of the lower division. The high temperature at which this is delivered will serve both to accelerate and equalise the rate of generation in the latter, and prevent that fluctuation in the amount which is incidental to the use of too small a quantity of water.

As enough has probably been here said to explain the nature of this boiler, it will be sufficient to refer to the specification for other supplemental particulars; but its general advantages may, in conclusion, be thus stated:—*Firstly*, An increase in the efficiency of the steam equivalent to the weight of the column of water counterbalanced: or, in other words, the application of its hydrostatic pressure as auxiliary and additional to that of the steam upon the piston; the attainment of this without increased consumption of fuel or augmented internal pressure upon the boiler; *secondly*, the possession in the highest degree of the main source of the superiority of the tubular boiler, as a rapid and economical generator, viz., a large heating surface in proportion to the quantity of water to be evaporated; and the attainment of this by a comparatively simple, inexpensive, and durable construction. M.

## RAILWAY GAUGES AND LONG BOILER ENGINES.—MR. R. STEPHENSON'S REPLY TO GENERAL PASLEY.

[Addressed to the Directors of the Norfolk Railway.]

Gentlemen,—In the outset I may state that I concur generally with the engineering evidence given by Mr. Bidder and Mr. Marshall; I shall therefore confine my observations to the evidence of General Pasley, but before I direct your attention to the individual statements, I must observe that I have experienced considerable difficulty in dealing with them, in consequence of their being merely expressions of opinion, without adducing arguments or specific facts to support them. If the General had, after giving an opinion, stated the particular reasons or result of calculation which led him to such conclusions, then their validity might have been tested. In the present instance such a

course is doubly necessary, because the subject, from the tone assumed, is made not merely a scientific one, but one involving professional character. I shall, however, confine my remarks to the former.

General Pasley commences by stating that the description of engine was "one of extraordinary length, of such a length as was never used on the narrow or any other gauge."

From this statement everybody would conclude that this class of engine was not in very general use,—that little or no experience had been obtained of its peculiarities,—that it was an experimental engine possessing several obvious defects. Against this assumption I think it only necessary to state the fact, that upwards of 150 engines of this description have been in daily use in this country and on the Continent, for the last two or three years—that the long boiler has, by every experienced and partial locomotive manager with whom I have communicated, been received as a decided improvement, so much so, that since this class of engine was first introduced, the boilers of old engines have been in several cases, within my own knowledge, very considerably lengthened; thus offering the most incontestable proof that the old construction of engine is admitted to be deficient in length of boiler. You will bear in mind that I am now speaking of the boiler simply, the other parts of the construction of the engine, upon which General Pasley offers an opinion, I shall come to afterwards. I need hardly say that during the working of such a number of engines over such a length of time, it is impossible to conceive the avoidance of accident, if this construction of engine involved danger to the extent stated by General Pasley. But, as if to meet this argument, the General in his evidence qualifies his opinion of danger by saying, "that such an engine as the one in question can go at thirty or thirty-five miles an hour, and I think I have gone forty-five upon them."

I can only state my own experience leads me to a different conclusion, and that I have frequently been upon this descriptive engine when the speed far exceeded those above referred to, without the slightest accident occurring.

Oscillation in the body of the engine at high velocities I regard as inevitable, no matter what the construction may be; but this oscillation arises from causes which cannot have come within the Inspector-General's sphere of observation. It is only the practical man whose opinion on such points can be depended upon; it is not the occasional riding upon an engine that can enable any one to decide between the construction of one class and another, or to decide that dangerous oscillation is caused by an overhanging fire-box or a long boiler. In a word, to decide a point of this kind it is absolutely essential to examine the condition of the engine as well as its construction; for instance, the steadiness of all six-wheeled engines essentially depends upon three conditions.

1. The distribution of the weight upon the three axles.

2. The lateral play in the bearings.

3. The distance between the extreme axles, that is, the extreme length of bearing upon the rails. Of these the last only is permanent, the two first are constantly subject to change; an engine which is perfectly safe and comparatively steady to-day, may become unsteady and even dangerous at high speed in a short time, by an alteration either in the springs or by the lateral wearing of the bearings. Now I have reason to know that the White Horse, of Kent,—the only engine which General Pasley quotes, as having oscillated excessively, although he has tried several others,—was not in the best working condition at the time he made the experiment; no opinion with reference to its motion could therefore with propriety be drawn, without taking into account the condition in which the bearings were at the time, together with the disposition of weight upon the wheels.

All engines, when allowed to get play upon the bearings, become unsteady at high velocities, and oscillation from this source is aggravated if more than a due proportion of weight be thrown upon the middle pair of wheels.

I believe nearly all the accidents which have occurred by engines leaving the rails, are mainly attributable to want of attention to this condition. In bad weather, when the rails are slippery, the temptation to the engine-man to increase the weight upon the driving wheels is very great, and I have frequently known it carried to an improper extent. How far this may have operated in the Norfolk Railway accident cannot now be ascertained; but referring to that which took place during the progress of the experiments on the Great North of England Railway under the Gauge Commission, I have ascertained that this improper distribution of weight was one of the chief causes of the engine leaving the rails. On a piece of absolutely perfect road, this cause would in all probability not have produced the result; but in cases of this kind, the ultimate result seldom—very seldom indeed—flows from one cause; it is the concurrence of two or more circumstances operating in the same direction.

If accidents on railways arose from any peculiarities of construction in the engine,

we ought to have them every day. If the overhanging fire box, so much objected to by General Pasley, were dangerous, it would be absolutely impossible to work the London and Birmingham one day without a series of accidents. The engines upon that line have fire-boxes projecting beyond the bearing axle fully 4 feet 6 inches, being 5 inches more than the corresponding projection of the Norfolk engine. The London and Birmingham line has been worked now nearly eight years with an unparalleled traffic, with engines having overhanging fire-boxes, without any accident which can fairly be attributed to such a peculiarity of construction. I originally objected to this projection of the fire-box beyond the axle; but after an experiment, continued uninterruptedly for a series of years, with an enormous traffic, it would be absurd to reject such practical evidence, and to hold to such an opinion.

It was this evidence that led me to the construction of the now long-boiler engine, and the abandonment of the objection I originally entertained and acted upon. When I considered, moreover, that the London and Birmingham engines had, in addition to the overhanging fire-boxes, remarkably short bearing upon the rail, and, consequently, admitting of the overhanging weight operating with increased effect—the testimony appeared to me conclusive.

The London and Birmingham engines, in the commencement, had a bearing upon the rail of only 5½ feet, (they have since been extended,) whereas the Norfolk engines have a bearing of 10½ feet. On this point I need not confine my reference to the engines upon the London and Birmingham, because they are not peculiar to that line, they are to be found in many others. Whatever may be the effect of such evidence upon the minds of others, I must confess that to me it appears perfectly conclusive that the overhanging box exercised no influence such as General Pasley imagines.

In confirmation of this, I may state that yesterday with a passenger train of 40 tons, with a boisterous side wind, I came from Darlington to York on the A engine, which has an overhanging box and long boiler, accompanied by Mr. T. E. Harrison, Mr. Fletcher, and Mr. Joseph Stevenson, for the express purpose of trying the oscillation of the engine. For several miles, the speed exceeded 50 miles an hour, and in some, we passed the consecutive ¼-mile posts in 15 seconds, being 60 miles an hour. In addition to the overhanging fire-box, we were all standing on the foot-plate with the engineman, excepting Mr. Joseph Stephenson, consequently the circumstances were peculiarly calculated to excite oscillation, if the tendency existed to any appreciable extent. I am, however, enabled to declare most positively that this engine was not only entirely free from any dangerous oscillation, but as steady as any engine I ever rode upon.

Here I will leave the question of overhanging fire box, and proceed to notice the next peculiarity of the Norfolk engine, specially noticed by General Pasley; viz., *The wheels being huddled together.*

In looking at this part of the subject, I am relieved from any discussion as to matters of opinion; it is simply one of dimension, which admits, happily, of no dispute. I therefore give you the dimension of Slaughter's engine, which the General returned to town upon, and declared safe and steady, and those of the Norfolk engine, which he condemns.

| | Feet. | In. |
|---|---|---|
| Slaughter's engine, distance between extreme axles .. | 11 | 0 |
| Norfolk engine, ditto .. | 10 | 6 |

I leave the General to say whether this difference of six inches justifies the epithet, "huddled together," as applied by him to the wheels of the Norfolk engine.

The General in another part of his evidence, says, "These engines, (alluding to Slaughter's) although they are of a long-boiler construction, have no overhanging weight like Mr. Stephenson's." This, like the last, is merely a question of dimension; the fact being, that at the chimney-end Slaughter's engine overhangs precisely to the same extent as the Norfolk engine; viz., 4 feet 9 inches. At the fire-box end, in Slaughter's engine, the axle is placed underneath the middle of the fire-box; whereas, in the others, it is placed immediately in front of it; without, however, giving the engine more than 6 inches additional base upon the railway, and this in a distance of 11 feet. Yet this shade of difference, according to the General, makes the one engine safe and steady, and the other dangerous and apt to "roll like a vessel at sea;" and this, without reference to the fact that the centre of gravity of the Norfolk engine is fully a foot lower than Slaughter's. Were it necessary to adduce any further evidence, it would only be requisite to recall to mind the base of the London and Birmingham engines, where, with an overhanging fire-box, the base at the rail does not exceed 7 feet.

I do not think that comment on such a conclusion is necessary; if a shade of difference of this kind be really adequate to produce such consequences as are here stated by the Inspector-General, the sooner the construction of every class of locomotive engine is revised the better.

General Pasley states, in another part of his evidence, that the narrow gauge "not offering so great a diameter of boiler as the broad, Mr. Stephenson, to remove the obstacle, constructed the long-boiler engines to equal them in power, and they have failed in the purpose for which they were intended;" and again, "that owing to the fore-part of the boiler being so far from the fire-box, the tubes being so much distant, the engines do not afford the power that was expected from them."

This paragraph I have no hesitation in declaring to be entirely erroneous. In the first place, the motive for lengthening the boiler had no reference to gauge at all, because it is equally applicable to all gauges: the object was to save fuel by preventing the escape of a large quantity of waste heat up the chimney; in this it has been perfectly successful, which has been established by every experiment hitherto tried with this object. Even with the longest tube yet introduced on locomotive engines, the temperature at the chimney-end has been found sufficient to melt lead, which is upwards of 200 degrees above the temperature of the water in the boiler. The opinion of General Pasley on this point is equally at variance with the most extensive experience with stationary engine boilers, which are much longer with much less velocity of draft.

It must be obvious to every one, that every addition to the economy of fuel obtained by an enlarged evaporatory capacity is necessarily attended with a corresponding increase of power; and therefore, as before observed, although my original object in lengthening the boiler was with the view of economical results, it has been attended with a large increase of power. I beg, therefore, to remove the impression produced by General Pasley's evidence by emphatically declaring that the long boiler arrangement suggested itself to my mind, indeed was in actual operation, years before the question of gauges was agitated. I forbear here going into the question of gauge which has been so pointedly introduced by General Pasley, both in his evidence and in his letter in this day's *Times*, because it is both foreign to the subject, and can lead to no result, whilst it is under the consideration of the commission appointed for that purpose.

In conclusion, I am willing to believe, nay I am sincerely convinced, that General Pasley, in giving his evidence, was actuated by no other motive than a wish to arrive at the truth; but in the present instance I must be excused for regarding him as having ventured to give opinions upon a difficult subject, and one with which neither his education nor experience can have made him thoroughly acquainted. In venturing thus to express myself, I am far from wishing to imply the least disrespectful feeling to General Pasley: on the contrary, my experience of the mode in which he has filled the difficult office of Inspector-General, has led me to respect him, and at all times to aid him, by giving him opinions on practical subjects whenever an opportunity presented itself; but in the present case I am so personally involved by his evidence, and feeling so strongly convinced that his views are entirely erroneous, and calculated to injure railway interests, that to express my opinion with any reservation would be injustice to many railway companies whose confidence I enjoy.

I am, Gentlemen, your obedient servant,
ROBERT STEPHENSON.

14, Great George-street, Westminster,
January 21, 1846.

## PROFESSOR FARADAY'S MODE OF PRODUCING THE ROTATION OF A RAY OF LIGHT BY MAGNETIC FORCE.

Professor Faraday, in further illustration of his late discoveries with respect to the rotation of magnetism and light, exhibited, at the Royal Institution, last week, the following remarkable experiments. We extract the account here given of them from the *Athenæum*.

The well-known oxy-hydrogen light of Drummond supplied the ray of light. This light was so directed by an arrangement furnished by Mr. Darker, as to make distinctly visible, over the whole theatre, all the phenomena of circular polarization which were required to illustrate Professor Faraday's newly-discovered principle. A beam of common light was shown to be separable into two distinct rays of polarized light; and the properties of these, and their relation to each other, were repeatedly demonstrated to the spectators. Such being the subject of his operations, Professor Faraday next exhibited the nature and extent of the force employed to accomplish his results. That force is magnetism derived from an electro-magnet of immense size and power. The magnet used was a half link of the former East India moorings, surrounded by several coils of thick copper wire, and the source of electric power was Grove's battery, about twenty cells of which were employed on this night. To give an idea of the force of this electro-magnet, Professor Faraday mentioned that once, while he was at work in the laboratory, an iron candlestick which happened to be standing on the table near its poles, instantly flew to them, attracted with such

violence as to displace or break everything in its way. The great experiment of the evening was then successfully tried. A prism of heavy glass was so adjusted between the poles of the magnet as to receive the oxy-hydrogen light after it had been polarized, and before it was depolarized by Nicholl's eye-piece. The following facts, demonstrating the magnetism of light, were then exhibited:—

1. As to the *rotation* of the ray.—A polarized ray, having been extinguished by the depolarizing plate, was instantaneously restored when the magnetic current was sent through the prism through which the ray was transmitted; and conversely, the polarized ray, when, by the common adjustments of the plate, it had been made visible, was extinguished by the force of the current.

2. As to the relations of this electro-magnetic power to other laws of polarized light. The rotation having been established, it was shown, (*a*) that the direction of the rotation was absolutely dependent on that of the magnetic force. (*b*) That, while in common circular polarization, the ray of light always rotates in the same direction *with regard to the observer* (to whatever part of the medium his view may be directed,) it is very different in the state of the ray induced by this new force. When brought under the influence of the magnetic current, polarized rays always rotate in a constant direction with respect, *not to the observer, but to the plane of the magnetic curves.*

Professor Faraday concluded by throwing out some general notions as to the possible developement of these researches in the line of future investigations. It did not seem impossible to him that the sun's rays might be found to originate the magnetic force of the earth, and the air and water of our planet might be proved to be the dia-magnetic media in which this condition of the force was eliminated.

## IRON STEAM VESSEL-BUILDING ON THE MERSEY.

Amongst the numerous objects of interest which Liverpool presents, perhaps few are more important than the progress now making in the new and rising art of Iron Shipbuilding.

The extensive new premises erected by Messrs. Vernon and Co., being highest up the river, first require attention. No expense has been spared by these builders to provide the most efficient means for carrying on their work. Three very fine ships are now on the stocks. The first is the *Windsor*, of about 800 tons, building for the City of Dublin Company, from the plans of Mr. Grantham. The second vessel, of the same dimensions as the *Windsor*, is for the Cork Company, and is called the *Ajax*. The third is a very large steamer, of about 1300 tons, building for the Peninsular and Oriental Company; this vessel is about half plated. Messrs. Vernon and Co. have orders for two more steamers, one of about 700 tons, also for the Cork Company, and of one 300 tons for Fleetwood, from Mr. Grantham's plans. [The *Windsor* and *Ajax* have been both launched since this notice was written.]

At Messrs. Hodgson and Co.'s works, Brunswick Dock, five iron vessels are now building. That nearest completion is about 250 tons, and is to be worked by a screw. She is intended for Buenos Ayres. The next is the *Antelope*, of nearly 600 tons, intended as a packet-ship between this port and the Brazils. She is of great length, and very fine lines, and is to be powerfully rigged. The next to her is a large vessel for the New York trade, to be about 1000 tons old measurement, or 1500 tons new. She is to be heavily rigged, and with four masts. These two last vessels are built from the plans of Mr. Grantham, and are to be propelled by the screw, on the direct principle.

Two other vessels are in this yard: one for Bombay, of about 300 tons, and one for the Woodside Ferry.

Mr. Cato has orders for four vessels, all from the plans of Mr. Grantham: one of 650 tons, lately launched but not yet completed, for the City of Dublin Company, to be worked by paddle-wheels. Also two vessels of 300 tons, which are for the same Company, to be fitted with the screw-propeller, and rigged as three-masted schooners.

Mr. Laird, the well-known builder at Birkenhead, has also five steamers in the course of construction. The frigate "*Birkenhead*," of 1400 tons, lately launched, is now receiving her engines in the Trafalgar dock, and looks remarkably well.

Three other vessels are intended for the Folkstone station, to be similar to a beautiful steamer lately completed for the same line, named the *Prince Earnest*, which has been highly approved of for her speed and good qualities.

The first iron steam vessel which appeared on the Mersey was built in Staffordshire and came here in 1824, and the first that was built here, was constructed by Messrs. Fawcett, Preston and Co., in 1829; both of these were intended for the inland navigation of Ireland. They have been constantly at work, and are said to be still in good condition.

While on this subject we may relate an interesting fact that has come to our know-

edge. In Mr. Grantham's work on Iron Shipbuilding he describes an iron steamer, the *Aaron Manby*, which was built in this country in 1821, and sent to the Seine, where she worked between Havre and Rouen. This steamer, with two others built about the same time, have been most severely worked and much neglected, but were, on examination lately, found to be in such good condition that a firm in Rouen has undertaken to lengthen them, preparatory to receiving new machinery, and being again fitted for service.—*Liverpool Standard.*

## CAPTAIN BEADON'S PATENT ROWLOCK.

[Patent dated July 29, 1845; Specification enrolled January 29, 1846.]

Fig. 1.

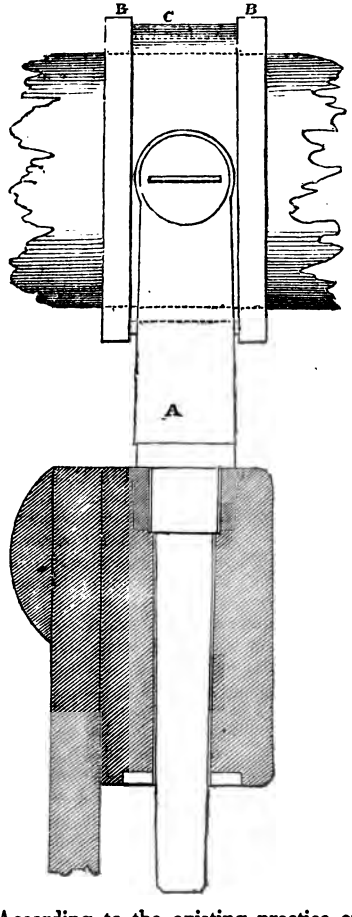
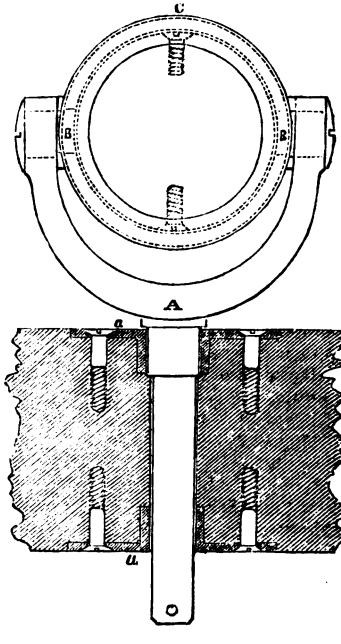



Fig. 2.




According to the existing practice of boat-rowing, the play which it is found necessary to allow between the rowlocks, or thole-pins, gives the oar during the operation of rowing a strong tendency to slip backwards and forwards on the gunwhale from one pin to the other, and this is attended with a good deal of noise, much chafing of the oar and gunwhale, and a real loss of propulsive effect. To obviate these evils, Captain Beadon, already so favourably known to the nautical world by his admirable Life Buoy, (see *Mech. Mag.* vol. xxxviii. p. 17,) has invented

the much-improved rowlock represented in the above figures. A A, is an upright metal crutch, which is made fast to the gunwhale by means of screws passed through plates, *a a*, slipped over the stem or shaft, and so as to allow that stem to turn freely in its bearings. B is a U-shaped piece, which is gimballed to the two sides of the crutch, and moves freely between them. C is a broad ring which is slipped over the loom of the oar, and has a deep groove on its outer face, by means of which, when it is dropped into the hollow of the gimballed U-piece B, it fits upon it exactly, and is thereby held fast. As the crutch can turn round on its shaft to any angle, and the gimballed U-piece, B, allows also of any required up or down movement, the oar can thus be moved in any direction without either noise or chafing, or the least loss of power.

Instead of the crutch and gimballed U-piece being fixed to the gunwhale, as represented in the engravings, the entire apparatus may be attached to the oar and fitted to its place when required, by inserting the stem of the crutch loosely in the hole made for its reception in the gunwhale, but in this case, the gimballed piece, B, should be entirely circular, instead of being of the U-shape before described.

### THE MOOZUFFER EAST INDIAN STEAMER.

On Tuesday last, a large first-class steamship, called the *Moozuffer*, built for the East India Company, by the eminent builders Messrs. Henry Fletcher, Son, and Fearnall, was launched from their Dock at Limehouse. She is of 1440 tons, registered burden, and will prove a valuable addition to the Company's steam fleet: her length over all is 250 feet; the depth in hold is 21 feet; breadth 37 feet, and to the outside of the paddle boxes 60 feet. She will be propelled by a pair of engines built by Messrs Seaward, Capel and Co. On testing the *Moozuffer*, after her first immersion in the water, it was found that her variation from a straight keel (as laid down) was within one inch; a slightness of variation between the calculated and actual displacement, such as is but rarely realized even with vessels not half her length and ponderous mass of materials. By some builders, indeed, it is no unusual practice to camber the timbers in laying down in order to provide for deviation, which is frequently 3, 4, and even 6 inches. The circumstance, therefore of the *Moozuffer's* deviation being so small, although laid down with a *perfectly straight keel*, is a safe guarantee that the greatest skill and care have been bestowed on the construction of the vessel, and also that the choicest and best materials must have been selected.—*From a Correspondent.*

### APPLICATION OF ELECTRO-MAGNETISM TO RAILWAY TRACTION.

Sir,—Nearly two years ago I conceived the idea of forming the tractive connexion between the first carriage of a train and the piston within the vacuum tube of an atmospheric railway, by precisely the same means for which, as is stated in the *Mechanic's Magazine* of the 24th of last month (No. 1172,) Messrs. Conder and Taylor have lately obtained a patent,—namely, by the action of electro-magnetism; and the arrangements I contemplated for effecting this mode of connexion were identically the same, with some additions, in every particular with those described in your publication. I fully intended including the invention in a patent granted to me upwards of six months ago for improvements in propelling carriages on railways, the specification of which has been recently enrolled, but was prevented from so doing by discovering that the same method, with no essential difference, forms part of Mr. Pinkus' specification of 1834; which is, of course, fatal to the pretensions of any subsequent inventor to a patent for the same invention.

I have the honour to be, yours obediently,

J. TEMPLETON.

February 4, 1846.

### KANGJAR ROPEMAKING.

Sir,—In the work on Eastern India, published by Montgomery Martin, vol. i. p. 360, the following sentence occurs:—"The Kangjar make ropes of the grasses called sabe and muj. They twist them by means of two cylinders turned by a string, first drawn one way and then the other, but the cylinders turn always in the same direction." The writer adds, that this mode of producing motion is known, but not much used in Europe. I should think that the Kangjar tribe are in a very primitive state of society. Their machinery cannot therefore be complicated. In what manner, then, is the string arranged round the cylinder, so that, by pulling first in one direction, and then in the opposite, continuous motion in the same direction is produced. I have shown the passage to several persons, who can give me no explanation.

Can any of your readers or correspondents explain this problem?

I am, Sir, very truly, yours,

INQUIRER.

Newcastle-upon-Tyne, Jan. 26, 1846.

### THE RETRACTED ASPERSIONS ON THE "METEOR"

Sir,—In your last Number, under the head of "*Meteor* Steamer," there is a letter signed "Curve," in which an apology is made for a former illiberal and unfounded criticism of the *Meteor*, in which an inference was attempted to be drawn that her speed was attributable to (in great part) so extreme a fragility of construction as to render her next to unsafe, even on the "smooth waters of the Thames." Although "Curve" has *now* done what is right, and done it not grudgingly, how does he make amends for the injurious effects which his former erroneous, yet most positive assertions may have produced upon the character of the vessel, and on the professional reputation of her constructors? To speak the simple truth, the form and *proportions* of the vessels, and effectiveness of the machinery, both of the *Meteor* and of the *Prince of Wales* (also built by Messrs. Miller, Ravenhill and Co.,) were *positive* and *material advances* made at the time of their construction, and have not since been excelled, if equalled; and accordingly, *both* were assailed by such detraction, as up to that time I could not have imagined conceivable. I am, Sir, your obedient servant,

RECTILINEAL.

February 2, 1846.

### EXPANSION OF STEAM.—MR. WATT'S CLAIMS.

Sir,—There are three reasons given by "Pressure not Puff," from which a conclusion in favour of Watt's publication of the mechanical advantage of the theory of the expansive action of steam previous to Hornblower's patent in 1781 have been deduced. These reasons were slightly adverted to by "S S," in proof of the independent originality of Watt's discovery. The first and second reasons; viz., a private letter, and experiments in a private factory; if admitted as full proof of knowledge, seem equally conclusive against the publication of that knowledge, as neither letter nor experiments were ever mentioned until a period long subsequent to 1781. The third reason alluded to by "S S," as experiments at Shadwell, assumes the form of the manufacture and sale of an expansion engine for the Shadwell Water Works Company in 1778.

I may be permitted to admire the ingenuity of these assumptions without admitting their accuracy.

The question is then asked, "Can it be supposed that under such circumstances a new principle of so much importance, not inferior to separate condensation, could have been kept secret, especially when the eyes of the mechanical world were closely watching Watt's proceedings?" Without the least hesitation I should answer in the affirmative. It was not only possible but probable in 1778, though this would not be the case in 1846. The eyes of the mechanical world were not fixed on Watt's proceedings at so early a period. Witness the next sentence, which alludes to the difficulties of Watt's early career and the equally well known difficulties which occurred in the sale of the first engines made at Soho.

The remarks of "Pressure not Puff" in other papers, also show the little importance that had been attached to expansion of steam, except perhaps in Cornwall, until within the last ten years.

The errors of this gentleman are analogous to those which have destroyed Hume's credit as an historian; viz., the application of the opinions and feelings of his own time to the actors in a preceding age.

Enough, however, has been shown to throw some doubt how far Hornblower's and Nasmyth's cases are exactly parallel; sufficient to induce me to ask my fellow-correspondent for information on the following points.

At what time, and by whom, were the claims of priority of publication of expansion brought forward on Watt's behalf?

Whether any person, unconnected with the Soho foundry, or not under the promise of secresy, was acquainted with the experiments at Shadwell on expansion? In fact, whether they were public or private experiments?

The statements that I have met with entirely confirm the concise but decisive view which Tredgold has taken of this question of Hornblower's claim as original patentee of expansion. Piracy, as regards condensation, was established against him in a court of law; but during the

trial, so far from the question respecting expansion having been mooted, it seems to have been carefully avoided; nor has any charge of piracy on this point been ever brought forward by Watt or his friends. Yet some fifty or sixty years afterwards, the assumption of the manufacture and sale of an expansion engine in 1778, by Watt, distinctly insinuates such a charge. There may be remarked in the wording of Hornblower's patent, a clear straightforward claim to expansion of steam in a second cylinder, which bears the stamp of truth; while, on the contrary, the latter portion of the patent relative to condensation bears the impress of an attempt at the evasion of Watt's patent right of separate condensation. The suppression of Hornblower's statement respecting the time of his discovery of expansive action in 1776, as first published by Dr. Gregory, is a most discreditable transaction,—to some parties, at least,—and further, it is a blunder, since its utmost value as evidence, gives to Watt a seven years' priority of the knowledge of the value of expansion.

I remain, your obedient servant.

S.S.

February 5th, 1846.

### EXPERIMENTS IN BREWING ON THE BAVARIAN SYSTEM.

Sir,—If the following account of some experiments, which I was induced to make from the extracts you favoured your readers with from "Dr. Ure's Supplement to his Dictionary" on the Bavarian process of fermentation, in the No. for December 1844 of your valuable Magazine, be worthy of a place in your columns, it is at your service. I had made a few experiments on the Bavarian process, but found that the *attenuation* of the worts by this process was extremely slow. On April 10th, 1845, I took a small quantity of worts from a brewing of 30lbs. per barrel gravity. To this, at a temperature of 50° Fahr., I added a small quantity of bottom ferment, and by means of a small column of water forced a gentle stream of air into the fermenting liquid, which became diffused throughout the body of the liquid by passing beneath a perforated plate. In the course of the day it began to "cream over" the surface, from the development of carbonic acid gas, and on the following day the fermentation was going on most effectively.

During the course of the fermentation a slight froth formed on the surface, but the whole of the glutinous matter was precipitated as a gelatinous viscid mass on the bottom of the vessel. When the process had continued seventeen days it was attenuated to 6lbs. per barrel, or one-fifth of its original gravity, while the brewing from which this was taken, fermenting at the same time with ordinary ferment, and at a temperature of 60° (during the same length of time,) was only attenuated to 15lbs. per barrel, or one-half of its original gravity. At this time it had a rather *peculiar* but pleasant taste, somewhat similar to some ale that I fermented with bruised almonds. It was now put into a small cask with a handful of hops, and has stood exposed to the atmosphere (small quantities being occasionally taken out) till the present time, and has yet scarcely an appreciable acid taste.

The advantages that I perceive are to be derived from this plan are, the oxidizement of the gluten and its perfect precipitation, and that too from the oxygen of the *atmosphere*, and not at the expense of the oxygen of the *sugar*, and consequently its not being so liable to undergo further change, or to become sour.

I was prevented (from ill-health) from pursuing the subject further, and since that time have not had an opportunity. I am therefore emboldened to request you to lay the subject before your readers, in hopes that some of them may turn their attention to it. And am

Your obedient servant,

R. N.

Gateshead, Feb. 4th, 1846.

### ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

JOSEPH CLIFF, OF WORLEY, IN THE COUNTY OF YORK, *for certain improvements in the manufacture of alum and aluminous compounds from a substance not hitherto used for that purpose, and in the production of an improved fire-clay from the residuum thereof.* Patent dated June 5, 1845. Specification enrolled Jan. 5, 1846.

Of the native fire-clays in ordinary use for the purpose of making fire-bricks, glass-house pots, retorts, crucibles, and other like articles, there are few, if any, which do not

contain an intermixture of substances, more or less injurious to the quality of the manufactured articles. Very commonly they contain alumina in excess, in consequence of which the articles made from them are apt to contract scale, disintegrate, and break, when subjected to long continued strong heats, or sudden and excessive changes of temperature, and more particularly when exposed at a high temperature to the action of acid vapours. In other cases the clays contain iron and lime, both of which are not only injurious in themselves, but, at high temperatures, act as a flux to the other materials which enter into the composition of such clays. The articles made therefrom are thus rendered easily fusible by an intense heat; and furnaces, or other articles made or built of such clays or bricks made from such clays are soon worn out or destroyed.

Now the nature of the invention which forms the subject of the present patent is such as to enable the manufacturer completely, or in a great measure, to remedy the said defects, and so to apportion the silica and alumina in the clay-brick, or other manufactured articles, as to prevent the contraction or flying in pieces, to obviate the tendency to fusibility which may arise from the presence of injurious substances, and to make each composition of clay such as shall be best fitted for the particular work to which it is intended to be applied. It consists, first, in separating from fire-clays any excess of alumina which they may happen to contain previously to applying them to the manufacture of fire-bricks, glasshouse pots, gas retorts, crucibles, and other fire-resisting articles, and converting such alumina into the alum and alum salts of commerce. And, secondly, in making use of a particular species or description of fire-clay, which contains the alumina in more than ordinary abundance, and is at the same time unusually free from iron and lime, and which species of fire-clay has not, to the best of the patentee's knowledge, been heretofore made use of in the manufacture of alum, or of any aluminous compounds. The particular species or description of fire-clay to which he refers is that known as the "Wortley bed of fire-clay," because of its being found in the greatest state of purity in the township of Wortley, in the parish of Leeds, in the county of York, and having been long employed there in the manufacture of fire-bricks and other fire-resisting articles. The same sort of clay is known to lie under part of the several townships of Leeds, Holbeck, Beeston, Beeston Royds, Farnley, and Armley, all in the parish of Leeds, and also under part of the townships of Pudsey and Eccleshill, in the parish of Calverley. It is further known, or to be reasonably inferred, from the geological position of this clay in the Yorkshire coal-fields, that it is to be found in a bed or beds immediately under the bed of coal known as the "Better-bed coal."

The manner in which Mr. Cliff carries his invention into effect is thus described:—

"I take the said Wortley fire-clay, or any other sort of fire-clay containing alumina in excess, and first grind it, then calcine it, and afterwards submit it to the action of sulphuric, nitric, muriatic, or other acid, more or less diluted with water, either with or without the assistance of heat. I then, by lixiviating the mass with water, obtain the alumina in solution, and set free from iron by means of prussiate of potash, gallic acid, sulphuretted hydrogen, or any other known and ordinary agent for precipitating iron or its oxides. I then either evaporate the solution down by itself, and thus get the sulphate, nitrate, or muriate of alumina, according to the kind of acid I have used, or I mix the sulphate or muriate of potash, soda, or ammonia, with the solution, and evaporate and crystalize, so as to obtain the alum, salts, and then by washing form the alum of commerce.

"After the whole, or greater portion of the alumina has been thus separated from the fire-clay, I make use in manner following of the residuary earths, to manufacture therefrom, or therewith, a superior description of fire-bricks, glass-house pots, and other like fire-resisting articles. I either use these residuary or purified earths by themselves, or I mix them with some of the fire-clay in its native state, finely ground. When the fire-bricks, or other articles are to be used for the purposes in which there are many and great changes of temperatures; whereby there would be no risk of the destruction of the bricks, or other articles, by the contraction, causing it to crack in pieces; or when the bricks, or other articles, are exposed at high heats to the action of acid vapours; then I take a quantity of my residuary clay, with just as much ground native clay as will work up with water into a well-tempered plastic body, and afterwards make it into bricks or other articles, in the ordinary way; but I find, that the proportions in which the residuary clay is mixed with the ground native clay, ought to be varied according to the purposes for which the bricks or other articles are used, having regard to the fusibility, as well as to the before-said tendency of the bricks, or other articles, to be destroyed by splintering, from changes of temperature. These proportions must necessarily differ so much, that no general

rule for them can be laid down; but it may be observed generally, that the manufacturer can, by such mixtures of purified and native clays (no matter what the proportions may be,) always produce a better composite clay than any which can be found in the native state."

MOSES POOLE, OF LINCOLN'S INN, MIDDLESEX, GENT., *for improvements in apparatus for withdrawing air, gases, and other vapours.* (Communication) Patent dated 23rd June, 1845. Specification enrolled 23rd Dec., 1845.

The nature of this invention consists in a method of getting rid of the smoke from furnaces and also of the impure air from the combustion of gas, or from other sources of heat and light.

The *smoke apparatus* employed is a centrifugal blower, which in its construction very nearly resembles the common fan-blower. The axis is vertical, and is kept rotating by wheel-work, the action of which is maintained by a weight. In the centre of the fan-case are connected two pipes, or flues, one at either side; these unite into one flue, through which is withdrawn the smoke, &c., and it is impelled through a pipe at the periphery of the fan to the external air. A small pipe proceeds from the lower part of the fan-case to withdraw any water, or other liquid products that may form in the flues.

The apparatus for carrying off the bad air from gaslight, &c., consists of a tube with a trumpet-shaped mouth placed immediately over the flame; the upper part of which tube is covered by a conical cap, and is provided with perforations at the sides for the escape of the heated current. The cap and the perforated part of the tube are enclosed in a case, or hood, communicating by a pipe, either with the external air or with the suction-flue of the fan-blower. Immediately beneath the apertures in the bell-mouthed pipe are two openings communicating by pipes with two hollow globes which are intended to receive any condensed water that may form in the pipes.

JOHN GREENWOOD, OF CHURCH, LANCASTER, MANUFACTURING CHEMIST AND CALICO PRINTER; AND JOHN BARNES, ALSO OF CHURCH, CHEMIST, *for certain improvements in the manufacture of certain chemical agents used in dyeing and printing of cottons, woollens, and other fabrics.* Patent dated 8th July, 1845. Specification enrolled 8th Jan., 1846.

The chemical agents referred to in the title of this patent are stannate and stannite of tin.

The stannate is made by throwing into an iron crucible, heated to a low red heat, 22lbs. of caustic soda, 8lbs. of nitrate of soda, and 4lbs. of chloride of sodium, (common salt.) The mixture is gradually raised to the fluxing heat, and when deflagration takes place 10lbs. of foliated block-tin is added, and the whole stirred with an iron rod. The compound when cool is powdered, or it is crystalized by solution and evaporation; or a solution is raised to the crystalizing condition, and is then forwarded for the purpose of mordant.

A solution of stannate of tin for dyeing purposes is produced by a similar process.

The stannate of tin is thus prepared: 4lbs. of common salt, 13½lbs. caustic soda, and 1lb. of nitrate of soda, are raised to a red heat in an iron crucible, and 4lbs. of foliated block-tin are added. The mixture is fluxed, and then cooled, and is treated in the same manner as in the preparation of stannate of tin. The patentee states that when nitrate of potass is used in this process, the proportion must be varied according to its different atomic constitution; the object always being to furnish one atom of oxygen in the formation of the stannite, and two atoms for the stannate.

The claims are; *first*, for the combination for procuring the stannate and stannite of tin; *secondly*, for the manufacture by fluxing; and *thirdly*, for the manufacture of dyers' liquor by the above process.

JOHN CONSTABLE, OF THE CITY OF LONDON, MERCHANT, *for certain improvements in the manufacture of gas for lighting and heating.* (Communication.) Patent dated 24th May, 1845. Specification enrolled 24th Nov., 1845.

The improvements which form the subject of this patent consist in the production of gas for lighting, &c., from *anthracite* coal. The patentee employs for this purpose a furnace, in form precisely similar to the common iron smelting furnace; with the exception of a contraction in the lower part of the furnace immediately above the bosks, and also of the addition of a plate or cover at the top of the furnace; which is provided with a hopper for supplying the anthracite, and a sliding door, or valve, for closing the neck of the hopper. The furnace being lighted, and then charged with anthracite, a stream of heated air (hot blast) is injected by a suitable pipe, fitted air-tight, immediately above the hearth of the furnace. The force of this current need not exceed four or five ounces per square inch. A jet of steam raised to 300° Fahr., is also admitted close to the aperture for the hot blast; and the two combining are forced through the ignited anthracite

producing the well-known gaseous oxide of carbon, which is conveyed from the interior of the furnace by an outlet pipe (furnished with wire gauze to separate the dust and cinders) to the gasholder.

The claim is, for the production of the oxide of carbon by the means above described; but the patentee states that the same arrangement may be used to produce amoniacal gas by introducing with every 24 parts of anthracite six of common pearl-ash. When the ignited mixture ceases to evolve the gas, the cinders and ashes are available for the produce of cyanuret of potass, by repeated washings with water, and subsequent evaporation of the solutions; or the ashes may be at once employed as a manure.

JOHN HOPKINS, OF BRAND-STREET, GREENWICH, *for certain improvements in rails and trams for railroads and tramways.* Patent dated 3rd July. Specification enrolled 3rd Jan. 1846.

Mr. Hopkins claims, as the subject of this patent, the application of blocks or surfaces of wood, placed and fastened in frames of iron, either with the grain of such wood downwards or otherwise, for the purpose of forming or constructing rails, or trams, or continuous wooden surfaces for railroads and tramways, and on which rails or trams, the peripheries of the wheels of the carriages or other vehicles travelling or running shall travel or run on blocks or surfaces of wood. But he does not confine himself to any particular form or size of blocks or surfaces of wood, or to any particular form or size of such frames of iron.

JOHN LEIFCHILD, OF THE MINORIES, LONDON, *for improvements in the manufacture of blue, to be used as a substitute for stone-blue.* Patent dated July 8, 1845. Specification enrolled January 8, 1846.

Mr. Leifchild's substitute for the ordinary stone-blue is a compound prepared by combining those blues known in commerce by the names of Chinese blue and Turnbull's blue, with oxalic acid, so as to render them soluble in water. The mode of preparation is as follows: — Four parts, by weight, of Chinese blue, one of Turnbull's blue, and one of oxalic acid are well mixed together, and boiling water is gradually added, until the whole is dissolved; and then to this combination an addition is made of one part, by measure, of the liquid called sulphate of indigo, which is produced by mixing one part of indigo with four parts of concentrated sulphuric acid, and afterwards neutralizing the excess of acid by means of carbonate of ammonia. The combined liquid, when required for use, is reduced in intensity of colour, to the extent desired, by the addition of water: it is then ready to be employed for bluing linen after washing, as hitherto practised when stone-blue in water has been used.

JOSEPH MALCOLMSON, OF PORTLAW, COUNTY OF WATERFORD, *for improvements in apparatus used for propelling carriages on roads, and vessels on inland waters, when employing atmospheric pressure.* Patent sealed 12th July, 1845. Specification enrolled Jan. 12, 1846.

1. The present patentee claims, *first*, the adoption of a close pipe, independent of the travelling-pipe, connecting the air-pumps along the line, and enabling their being kept continually and unitedly at work in creating and upholding a vacuum in the main pipe. Under such arrangement, the engines, or other motive power, may be placed further apart, and may be of less dimensions, by which a saving of first cost and fuel is effected. The necessity of duplicate engines on each station will also be obviated, inasmuch as any engine getting deranged, the others will be available for the work.

2. And, *secondly*, the construction of the air-tubes of brick, tiles, earthenware, or glass, well caulked at the joints with asphalt, Roman cement, &c.

WILLIAM SYKES WARD, OF LEEDS, GENT., *for improvements in exhausting air from tubes or vessels for the purpose of working the atmospheric railways, and for other purposes.* Patent sealed 25th June, 1845. Specification enrolled 25th Dec., 1845.

1. The *first* of these improvements consists in so constructing the air-pumps employed that the power required for opening and shutting the valves is supplied by gearing, or mechanical movements, from the engine, or other source of power by which the air-pump is actuated, so that the inlet valves are opened and shut alternately, almost immediately after the commencement of the strokes of the piston of the pump, and the outlet valves are respectively closed, or pushed home, at the end or conclusion of the stroke of the piston. The gearing afterwards releases the valve, which is retained on its seat by the pressure of the external air, until the air within the cylinder of the pump becomes nearly of the same density as the external air, when the valve (if the lower outlet) falls by its own weight, or (if the upper outlet) is raised by a counterpoise of greater weight than the valve, or by a spring, thus moving rather in advance, or as though in anticipation of the current of expelled air, and affording a free passage for it.

2. A *second* improvement claimed consists in so combining certain large vessels or reservoirs with air-pumps in the working of atmospheric railways, that one of the pumps which may have been used in exhausting the reservoirs may, by a slight change of its communication with the reservoirs, be employed as an air-engine, in order that the power exerted by the air passing from the traction-tubes to the reservoirs may be made effective in assisting the steam-engine, or other motive power, in working another pump; and also, that when the air in any of the reservoirs becomes of greater density than the air in the traction-tube, the air may be pumped from the traction-tube into such reservoir, with much less expenditure of power than in pumping from the traction-tube into the atmosphere.

3. The third and last of Mr. Ward's improvements consists of a new description of leathern packing for pistons intended to supersede the use of malleable pistons, which is thus described:—"I pack the pistons of air-pumps with leather cut into bands, or straps, of the breadth of about one-sixth part of the diameter of the cylinder of the pump. I prefer leather of ox-hide, such as is used for straps for working machinery. Such bands are united by sewing, and also with the wellknown cement of isinglass or fish-glue dissolved in weak spirit, or are united by other suitable means, so as to form a continuous circle of about the same diameter as the pump cylinder, but considerably conical, so as to facilitate the bending hereinafter mentioned The bands of leather, after being softened by water and placed upon a block of similar size to the piston, are then bent and contracted, so that about one-third part of the breadth may fit the cylinder and the other two-third parts may be attached to the piston, and secured by plates of metal screwed to the main part of the piston, but which screws being slightly loosened would allow the leather to be driven outwards, or towards the sides of the cylinder, after a portion of the said packing has become worn. The shaving off the hair side of the leather will much facilitate the forming it into the required shape, and also the cutting out gaps or notches where the screws or bolts will be required to pass. After the leathers are put into the required form, they should be well saturated with neat's-foot oil, or similar unctuous matter. The edge of the leather band being thus turned will form a portion of concave surface, which, being well supplied with oil or other suitable lubricating matter, will fit for the cylinder so as to be air-tight, and yet move with very little friction. Although it is well known that the leathers of the pistons of pumps constructed in a similar manner to that hereinbefore described, become the tighter the greater the pressure they are exposed to, yet the packing of the piston of a large air-pump must either be made somewhat more tight than advantageous, or when the pressure of the air on which it is acting is slight, the air will be liable to pass before the leather expands so as to fit the side of the cylinder. I therefore insert a series of springs, formed by cutting gaps or notches in plates of very thin steel similar to what is manufactured for making steel pens, forming the segments of a circle, and then bending the parts left to a similar form with relative portions of the bands of leather, so that the springs, after being tempered, may be inserted between the band of leather and the plates which fix it on the piston, the springs being first riveted on such plates. I construct and pack the upper and under sides of the piston in a respectively similar manner."

## CHANNEL STEAMERS.

On Thursday last the *Belgian Railway*, a very fine iron steamer fitted out for the Belgian Government, in order to carry the mails between Ostend and Dover, was tried down the river. She has been built by Messrs. Ditchburn and Mare, of Blackwall, and engine-fitted by Messrs. Maudslay and Field. She left Blackwall at 20 minutes past 11, and returned to her moorings at 20 minutes past 5; having gone down ten miles below the Nore and back in six hours, including a stoppage of some minutes at Woolwich. The trial was in every respect highly satisfactory.

The *Belgian Railway* is another of that class of vessels which within the last two or three years has created such a revolution in the channel-service, as regards speed and accommodation. Formerly, the insufficiency of the packet-vessels used to be the subject of constant and well-founded complaints; they were all wooden vessels, and though managed with great skill, the time they occupied in performing their voyages was very great under the best of circumstances, and in bad weather so much so, as to deter passengers from going with them. The first

step in advance was the purchase by Government of the *Dover*, an iron vessel built at Liverpool; her speed was about one-third greater than the old vessels. Then came the *Princess Alice*, whose speed was nearly twice as great as that of the old packets. She was followed by the *Princess Mary*, *Princess Maude*, and *Queen of the Belgians*, for the South Eastern Railway Company. The *Ondine* came next in order; she was built for a private company at Dover, but subsequently bought by the proprietor of the *Morning Herald* to carry despatches. The South Eastern Company then got the *Queen of the French* and *Prince Ernest*. The whole of these vessels, beginning with the *Alice*, have kept up the communication with France and Belgium *in all weathers* with the greatest regularity, and at times when the old vessels dare not "look at it." The Government finding that their old vessels could not compete with the private ones, and that they got none of the passengers, ordered several new ones to be built on the model and proportions of the *Princess Alice*. The *Onyx*, the first of their new batch, went to her station this week, and the *Violet*, her sister-boat, was, as well as the *Belgian Railway*, tried down the river on Thursday.

The following list exhibits, in a tabular form, the names of all the new vessels on this station, with those of their builders and the makers of their engines. We hope to be able, on some future occasion, to add the tonnage and the steam power.

| VESSELS. | BUILDERS. | ENGINEERS. |
|---|---|---|
| Princess Alice . . | Ditchburn and Mare . | Maudslay and Field. |
| Princess Mary . . | ditto ditto . | ditto ditto. |
| Princess Maude . . | ditto ditto . | ditto ditto. |
| Queen of Belgium . . | ditto ditto . | ditto ditto. |
| Ondine . . . . | Miller and Ravenhill . | Miller and Ravenhill. |
| Queen of the French . | Ditchburn and Mare . | Maudslay and Field. |
| Prince Ernest . . | Laird and Co. . . | Forrester. |
| Onyx . . . . | Ditchburn and Mare . | Penn and Son. |
| Belgian Railway . . | ditto dito . | Maudslay and Field. |
| Violet . . . . | ditto ditto . | Penn. |

## THE "SATISFACTORY" JANUS.

Sir,—Observing in your Magazine for January last, that you notice the engines in the *Janus* in three separate Numbers, I beg to inform you, that orders have *not* been given for the removal of the engines, and that they are still in our hands.

Remaining, Sir, your obedient Servant,

CHARLES ROBINSON, (late Bramahs.

Pimlico, Feb. 3rd, 1846.

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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

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Edited by J. C. Robertson, No. 166, Fleet-street. Double.


## COMMANDER BEADON'S PATENT IMPROVEMENTS IN SCREW-PROPELLING.

Fig. 1.

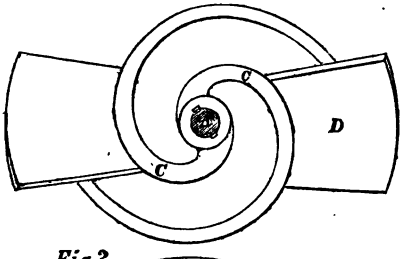



Fig. 2.

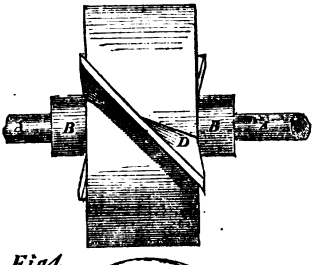



Fig 3

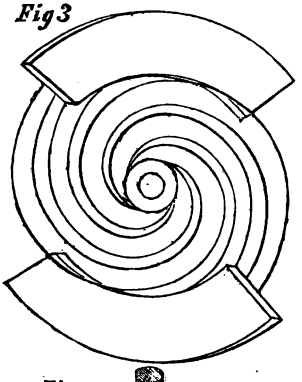


Fig 4.

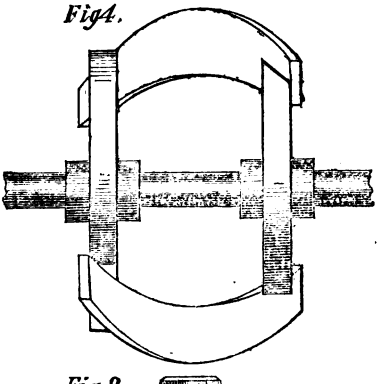


Fig 9.

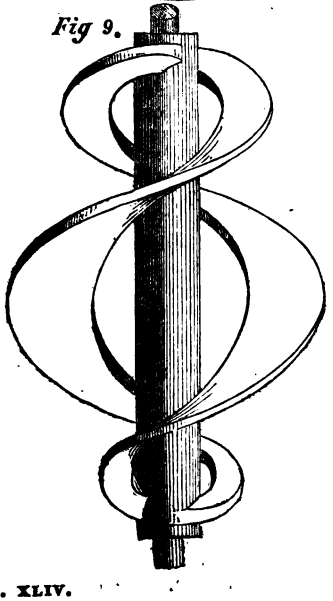
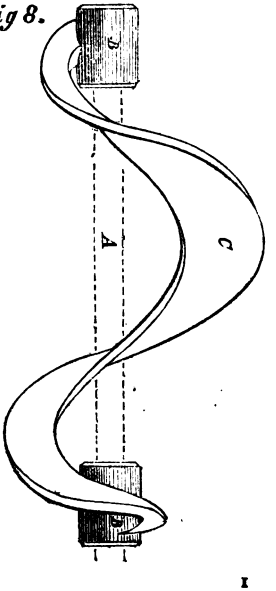


Fig 8.



## COMMANDER BEADON'S PATENT IMPROVEMENTS IN SCREW-PROPELLING.

[Patent dated July 29, 1845; Specification enrolled Jan. 29, 1846.]

THESE improvements include, 1, a new form of arm for the blades of screw-propellers, of whatever form these blades may be. 2. A new form of blade. 3. An entirely new form of screw-propeller, called the "Marine drum Propeller;" and 4, a method of shipping and unshipping submarine propellers, or of attaching them to, or detaching them from their shafts.

1. The *new form of arm.* Mr. Beadon introduces his description of this improvement with the following apposite observations:—

"Hitherto the blades, or propelling surfaces, have been attached either directly and bodily to the shafts, or to the ends of straight arms radiating from the shafts, and this whether the blades were curved or plain; for though it is well known that the most effective portion of such propelling blades, or surfaces, must of necessity be those at their extremities, and it has been therefore found expedient to reduce as much as possible, consistently with strength of construction, the amount of resisting surface at and near to the shafts; and though it has been further ascertained that curved blades are preferable to flat, because of their acting tangentially only against the water, yet it has been overlooked that for the same reasons the arms which carry the blades should also be made so as to oppose as little direct resistance to the water as possible."

Mr. Beadon proposes, therefore, that the blade-arm should be made of a curved or scroll form, instead of straight as heretofore:—

"I prefer that the curve given to the arm should be that of a volute, increasing gradually in distance from the centre of the shaft, as shown in figs. 1 and 2; the former of which represents a side elevation of a propeller, with arms of this description; and fig. 2 a vertical section. A is the shaft; B the boss, to which the arms are attached; C C, the curved arms; D D, the propelling blades. But the form of the curve may be variously modified without materially, if at all, increasing the resistance offered by the arm. Instead, also, of each blade being carried or supported by the curved arm only attached to it at the middle, it may be carried or supported by two curved arms attached to it, one at each end, as shown in figs. 3 and 4. And further, the convolutions of the arm may be either all in one and the same plane at right angles to the shaft, as shown in figs. 1, 2, 3, and 4, or in different planes, as shown in figs. 5, 6, and 7."

2. The *new form of blade.* Mr. Beadon proposes that the blade, instead of being as usual a segment of a regular screw, which is the form adopted by Lowe, Smith, Ericsson, and others, should be of a spheroidal form as represented in fig. 8.

"A, is the shaft; B B, two hollow bosses through which the shaft, A, is passed; C, is the spheroidally curved propeller, which is welded by the two ends to the bosses, B B. A double propeller on this principle, or a propeller of two turns, is shown in fig. 9. In this case, the blades are represented as welded to one long boss, which may in the first instance be set, and then bored out for the reception of the shaft."

3. *The marine drum propeller.* In this propeller all, or the greater part, of the *non*-effective portions of the instrument are enclosed in a water-tight drum, or cylinder, and so prevented from affecting, detrimentally, the action of the propeller. A longitudinal elevation of this propeller is given in fig. 10.

"A A, is the shaft; D, the drum, which consists of a number of separate compartments, strengthened internally by radiating arms. C, is a flat blade, wound spirally round the drum, with its edges at right angles to it. E E, are two semicircular pieces inclined inwards towards one another, which are affixed to the outer end of the drum, and operate as auxiliary propelling blades. When this description of propeller is applied at the stern, I prefer that it should be used in duplicate, that is, that there should be one such propeller fixed at each side of the keel."

4. *The method of shipping and unshipping.* The details of this method are represented in figs. 11, 12, and 13, and are thus described:—

"A, is the propeller-shaft, which is made in three pieces, $a^1$, $a^2$, $a^3$; $a^1$, being that to which the propeller is attached; $a^2$, a piece to which $a^1$ fits; and $a^3$ a piece which serves as a prolongation of $a^2$. C C, are collars attached loosely to the part $a^1$ of the propeller shaft, so as to allow the shaft to revolve freely within them. B B, are two horns or hollow cylindrical shafts, which are passed down through the quarters of the vessel and through stuffing boxes S S, and terminate on the outside immediately over the collars C C. $F^1$, $F^2$, are chains which are attached by eyebolts to these collars, and carried upwards through the cylinders, B B, to the windlasses O O. The cylinders, B B, are screw-threaded on the outsides, and carry at

Fig. 11. Fig. 10. Fig. 12.

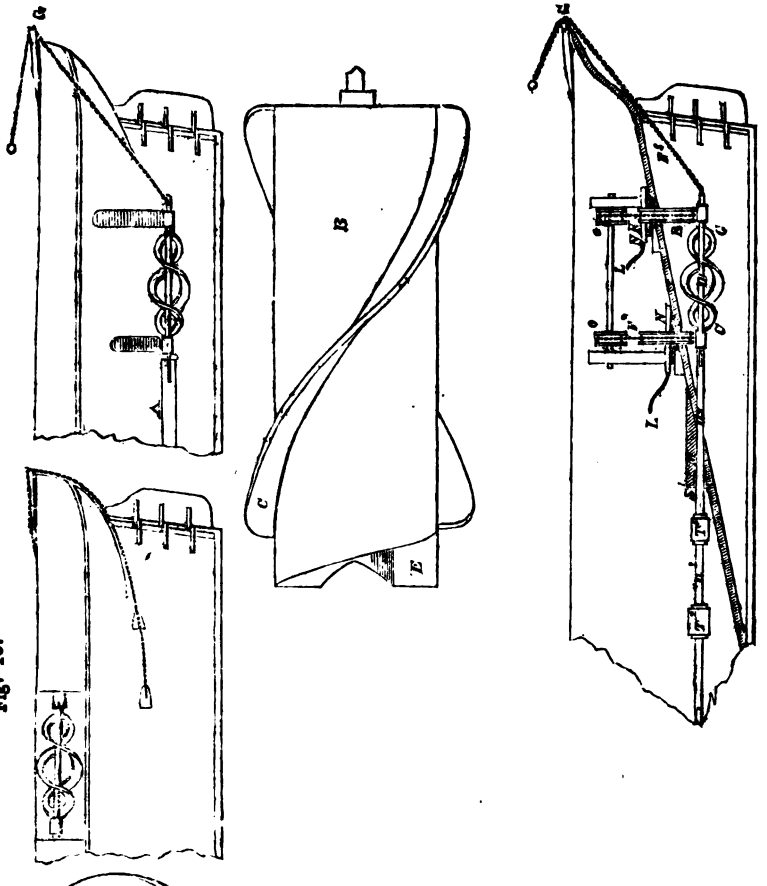



Fig. 13.

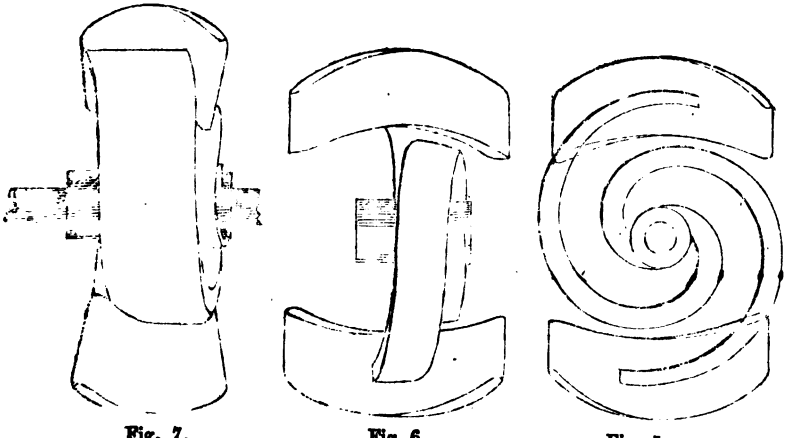


Fig. 7. Fig. 6. Fig. 5.

top two screw-nuts N N, by the application of a spanner L to which, they can be protruded or drawn in at pleasure. $F^3$ is a third chain that is attached to the after end of the propeller shaft, and carried over a pulley, G, mounted on the stern davit or some convenient part of fixture on deck; the piece $a^2$ passes through an orifice, H, in the bottom of the vessel, protected by a stuffing box S. The piece $a^3$ is attached at one end to $a^2$ by a coupling $t^1$, and at the other by a similar coupling $t^2$, to the other end of the crank-shaft 1. When it is desired to detach or unship the propeller, the piece $a^3$ is disconnected from $a^2$ and the crank-shaft by undoing the couplings $t^1$ and $t^2$ and the piece $a^2$ is then rigged in; the chains $F^1$, $F^2$, are then eased down and the chain $F^3$ hauled in. When the propeller is raised to the height of the stern pulley G, the chains $F^1$, $F^2$, are raised from the collars C C, and the propeller lashed to any convenient part. All the three chains are then hauled taut, in a fore and aft direction as shown in figure 13; at which point they can offer but little if any obstruction to the vessel's progress. To attach or ship the propeller the cylindrical shafts, B B, are rigged out by turning the nuts N N, and the chains $F^1$ $F^2$, again hooked on to the collars C C. The chain $F^3$ is then eased off, and the chains $F^1$ $F^2$, hove in by the windlasses O O. The piece $a^2$ is next rigged out till it clutches the end of the piece $a^1$ which carries the propeller. And finally, the piece $a^3$ is dropped in and reconnected to the piece $a^2$ at one end and to the crank-shaft at the other, when the whole apparatus is once more in gear and fit for action.

The whole of these improvements exhibit a most commendable degree of ingeniousness and originality, and are all of them well deserving of a trial.

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ON THE APPLICATION OF STEAM POWER TO LOCOMOTION.—BY MR. ALFRED SAVAGE.

Sir,—It has been asserted that there must be a velocity at which the whole pressure of the steam would only overcome the friction and inertia of the piston, and other reciprocating parts of a steam engine. Long ere this velocity could be attained the very wasteful revolving engine, consisting of a simple eolopile, (like the engine improperly termed Hero's, for he is only the earliest historian of that which was, like the reciprocating piston engine, known previously to his time,) or an eolopile inside a steam case, which is the true description of Craig's or Ruthven's engine, would be a far more economical machine.—When we hear of seventy miles per hour performed on railways by a locomotive, with driving wheels of ordinary size, we may naturally ask, whether the speed of the pistons must not have been such, as to aproximate so far towards the first condition, as to be attended with a very extravagant consumption of fuel; not to mention the rapid destruction of those moving parts which reciprocate? The present tendency to *go ahead* is so powerful, that we may expect 70 miles per hour will, instead of being only an experimental rate, become common rate of express trains ere many years have elapsed; and as a difficulty is said to be half overcome when fairly encountered, it may be desirable to proceed to consider the means at our disposal for effecting this, certainly not easy, result. Those means are

1st. Atmospheric propulsion.

2nd. Increasing the velocity of the piston in the common locomotive.

3rd. The use of larger driving-wheels.

4th. Some improved method of connecting the crank-shaft of the locomotive with the piston rod, so that it may perform more than one revolution for each complete stroke of the piston.

1st. With regard to atmospheric propulsion, I think it is pretty generally admitted that the question of its applicability to the great lines of railway was settled by Mr. Robert Stephenson's elaborate Report. It has at once the advantages and disadvantages of the stationary system; and nothing but the necessity of moving the trains at a speed unattainable by locomotives, or very unfavourable gradients, will be likely to cause its adoption on any long line. Its great recommendation is its safety, resulting from the absence of the heavy locomotive, and the impossibility of one train running into another. The defects of the stationary system are inseparable from atmospheric propulsion, and may be considered as conclusive against it.

2nd. The moving the piston much faster than pistons ought to move, is so objectionable that it could only have been employed in the absence of better. If the ports are of moderate size the steam on one side of the piston is employed in driving out the steam on the other, which certainly is not employing its power to any useful effect. Unless loco-

motives be constructed something like Mr. Maudslay's last patent engine for screw propelling, the waste must be very great indeed; and even then, would do nothing towards overcoming the objection, that the power required to overcome the inertia of the reciprocating parts, bears a large proportion to the total force of the steam; besides, when the pistons are driven with excessive velocity, they are running away from the force which moves them.

3rd. The employment of larger driving-wheels never appeared to me to have had a fair trial. The objection to Brunel's 10 feet wheels on the Great Western Railway, was the excessive oscillation of the engine sideways. Now it generally happens that inventors do not go the best way about anything at first. It seems to be the law of progress, that we must do wrong many times before we can learn to do right. I would humbly suggest, that if Mr. Brunel had remembered the old fashioned water-carts in use thirty years ago, he might have condescended to copy them so far as to place his locomotive *under* the axle. Nobody ever heard of a water-cart overturning, and I think the engine would not have oscillated to any dangerous extent had it been *suspended* instead of supported. Perhaps we may yet live to see a locomotive working economically on common roads in this position, when new railways are at a discount, as they surely will be ere long, from what the financier calls "over issues." This does seem the natural place for loads which are to be moved with great velocity; and I am surprised that so eminent a mechanic as Brunel did not place his load there. It may be not less morally than physically true, that the darkest place is immediately under the lamp; nevertheless, *that* lamp has been a shining light in the world, and the shadow is only dark by contrast with the intellectual splendour around.

4th. The fourth means consists *essentially* in the employment of toothed gear; the wheels either working directly into each other, or into something which connects them, as a chain. The latter form Mr. Walter Hancock employed in his common road locomotive, and is most convenient, when the power is far from the shaft, to be moved. The best form, however, in which I have yet seen it adopted, is on board of the *Great Britain*. For driving the propeller when the power is near the shaft, as is the case in a locomotive, it would be inferior to spur gear. It would also be inferior in a steam ship of any ordinary dimensions. All straps and band wheels, or wheels communicating motion by contact of surfaces, come, in principle, under the class of toothed gear; and the only difference between such a pair of wheels and a pair of spur-wheels, is, that the artificial teeth of the latter are much larger in proportion to the size of the wheels, and more equal and regular in form, than the asperities on the surfaces of the former, which prevent slipping. So also the similar asperities on the surfaces of drums and straps, correspond to spiked-wheels and chains, or the two spur-wheels and chain of the *Great Britain*. They are all essentially toothed gearing, whether the teeth work immediately in contact or are connected by an intermediate chain or strap. All the forms of this principle yet applied to locomotives are objectionable; the teeth of wheels and the links of chain are apt to break, and straps are out of the question when great power has to be communicated. There is a modification, however, of this principle which I am surprised is not in more use, viz. Franks' step-gearing, described in the Transactions of the Society for the Encouragement of Arts. This consists of several spur-wheels and pinions so arranged that before one pair of teeth is disengaged, one or more pairs are in contact. This affords a means of increasing the velocity to any required limits without inconvenient noise. Indeed a set of wheels having 1000 teeth each, may be made to cause a shaft to revolve 500 times for one revolution of the driving-shaft: it also has the great advantage of being free from noise. I should think this the best published means of communicating motion to the shaft of a screw propeller: I cannot see why it would not answer for a locomotive engine. At any rate, it is the least objectionable mode of employing toothed gear for communicating a high velocity to the shaft of the driving-wheels, (if that be necessary;) though I suspect, if the engine be suspended from the shaft, we may travel fast enough by enlarging the wheels. The vibration of the wheels themselves may be damped by enclosing

the spokes in saw-dust, which effectually stops their noise.

Respectfully,

ALFRED SAVAGE.

Mill-Maker and Mechanist, 43, Eastcheap.

P. S. The preceding remarks were written during the railway mania; since which the "over issues" of scrip alluded to have produced their natural effect.

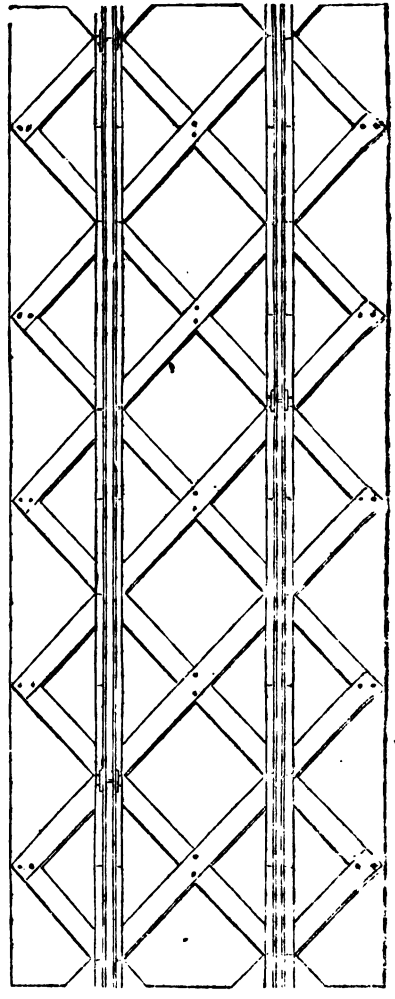
## HERRON'S PATENT RAILWAY TRACK.

(From the *Franklin Journal* for December, 1845.)

The engraving represents a plan of the railroad track invented and patented by Mr. James Herron, C. E., as it is laid upon the Philadelphia and Reading Railroad, between Valley Forge and Phœnixville, as seen before the trellis foundation was covered with earth.

The trellis, or diagonal sills, represented in white, are 3 inches thick, 8 inches wide, and 14 feet 9 inches long. These sills are of sawed white pine timber. They were laid upon the clay embankments, and in the wet cuts, *without any ballasting under them*; and, it will be seen, that they make an angle of about 45 degrees with the line of the rails. A second course, of the same-sized sills, laid nearly at right angles on the former, make, together, the latticed foundation for supporting the rails, as shown in the cut. These sills are *not* notched into each other where they cross, but are secured together, on the centre line and extremities, by two spikes driven in each crossing.

White pine and hemlock-string pieces, 5 inches thick, 8 inches wide, and about 20 feet long, are laid diagonally upon the latticed sills, and are united to each other at their ends by a suitable scarfing. The string-pieces were dressed to a thickness where they rest upon the intersections of the lattice, the inner side being made three-eighths of an inch thinner than the outer, for the purpose of inclining the surface of the rails to suit, as nearly as possible, the conical form of the wheels in use upon the road. The rails, represented by the heavy black lines, have a continuous bearing upon the string-pieces, with which they regularly break joint, while the latter are evenly supported by the strongly combined elastic trellis foundation.



The rails, string-pieces and trellis sills are secured together upon this track, by three-fourths of an inch screw bolts, two at each intersection of the lattice. And the ends of the rails are joined by chairs of wrought-iron, of a new design.

The whole of the timber used in this track underwent an antiseptic process. A solution of the bichloride of mercury being forced into the wood by a pressure of 100 pounds on the inch, the air being exhausted, nearly half a gallon of solution was forced into each cubic foot of timber.

The strength of the solution was one pound of sublimate to fifteen gallons of water, with the exception of 9,500 feet, laid between the 28 mile post and Phœnixville, prepared with a solution of only one pound to thirty gallons of water.

The simple soakage of timber in this solution (Kyan's process) has, almost universally, proved successful, both in the large quantities thus prepared in England, as well as in the more limited application of it, hitherto made in different States of this Union. And, where an occasional piece of timber has been found to decay, in some of the large lots prepared in England, (for as yet, there is no evidence of any timber *prepared with corrosive sublimate*, having rotted in the United States,) there is much reason to suspect that it was owing to decomposition having too far advanced in the heart of the piece at the time it was subjected to the process.

As the penetration by soakage, however, extends but little way below the surface of the timber in the generality of cases, it could not reach, and arrest the decay in progress at the centre; hence the more effectual process of forcing the solution into the body of the timber, to perfect saturation, has been adopted by the British Admiralty, and on some of the more recently constructed railways in England, as well as by Mr. Herron, who is believed to have made the first successful application of it, by hydraulic pressure, in the United States.

Security on this track is nearly perfect, for should an engine, or car, by any means be thrown off the rails, it will not be likely to result in any serious damage, as the trellis sills are covered by the ballasting, leaving nothing exposed, as the cross sills are, for the wheels to strike against, and thus shatter the carriages. And as the string-pieces and rails are strongly secured, they will serve as guards to keep the carriages from running off the embankments. Cases have occurred, where a car axle broke, and one or more wheels were thrown off the rails, yet the train continued on, in two instances, for more than a mile before the men upon the cars discovered it.

November 15, 1845.—This track has now been opened to the heavy trade one year and five days, during which time, *eight hundred thousand tons* (of 2,240lbs.) *of coal* have rolled over it. The gross tonnage of the coal trade, the cars and engines being added to the above, will make about 1,310,000 tons. And the whole *rolling tonnage*, including freight, passengers, and road materials, probably, 1,400,000 tons. The excellent condition of the track, and the ease of motion with which the cars roll over it, are proverbial.

The cost of *one mile* of Herron's patent track, as laid on the Reading Railroad, is said to have been 9,759·38 dollars, but this amount does not include the cost of widening the cuts and embankments, removal of slips, loose stone, solid rock, and ditching; nor the distribution of materials, straightening of damaged iron, cost of hydraulic Kyanizing apparatus, timber and other materials left and since used upon other parts of the road, &c.

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### STEAM SHIP-BUILDING ON THE THAMES. THE "METEOR," "PRINCE OF WALES," "HERNE," "SAPPHIRE," &c.

Sir,—I was very glad to see the handsome retractation by "Curve," of what he had advanced with respect to the *Meteor* river steamer; for, in common with "Rectilineal," I had noticed with some disgust the continued endeavours of certain parties (rivals, it is not unreasonable to suppose,) to decry the productions of a particular engineering firm, which, according to the best of my observation and judgment, have been deserving only of praise for their constant striving (with more or less success) after improvement in steam-vessel construction. Will you excuse me for adding, that it was also with some surprise and sorrow that I saw the *Mechanics' Magazine* made the favourite medium of the attacks to which I allude; having always been accustomed to regard it as eminent for its love of truth and fair play, and feeling well assured that the Editor must have been, somehow or other, unconsciously betrayed into lending a helping hand to the disparaging designs of Messrs. "Curve," Crook, and Co.* To come, however, to the more immediate purpose of my present letter,—I am desirous of adding a few facts with respect to the *Meteor* and her sister vessel, the *Prince of Wales*, which seem to me well deserving of all possible publicity. These vessels are still, to this day, as they were when first

* We have never inserted anything on the subject which we did not believe at the time to be true, or which was not, at least, so well accredited as to forbid any hesitation about publishing it.—Ed. M.M.

turned out from the hands of their builders, (Messrs. Miller, Ravenhill, and Co.;) that is to say, neither vessels nor engines have had any alteration made in them, having for its object to rectify any original error in construction. The *Herne*, on the contrary, which was built in the same year as the *Prince of Wales*, has been since lengthened, and made finer forward by the addition of a new head 15 feet longer than the old one; and this year she has had also a new set of paddle-wheels, and (if I am not misinformed) a new set of boilers. So likewise the *Sapphire*, (atmospheric engines,) another vessel of the same era, has been lengthened, and new boilered. And yet, all these alterations notwithstanding, the *Prince of Wales* is incontestably superior in speed to the *Herne*, and the *Meteor* not at all inferior to the *Sapphire*. Surely these are facts which do great credit to the professional skill of the builders of the *Prince* and *Meteor*, and justify me in challenging all and sundry, to produce two more remarkable instances of a thoroughly correct movement a-head in river steaming.

I am, Sir,
A FREQUENT PASSENGER
AND CONSTANT READER.

Finsbury, 8th Feb., 1846.

## THE VICTORIA TOILET.

[Registered under the Act for the Protection of Articles of Utility. George Smith, of Conduit-street, Upholsterer, Designer and Proprietor.]

Novelties in cabinet furniture are but rarely distinguished by so much ability as characterises the very elegant piece of furniture represented in the above engraving. The "Victoria Toilet" instead of having, as usual, but one mirror, is provided with three; one which is placed in the customary place at the back, and

supported between two vertical pillars, and two others, one on each side, which slide in grooves in the top surface of the table, and can be drawn out to any angle desired. By this arrangement, a lady sitting at the toilet can, without rising or the slightest change of position, obtain, at pleasure, a reflected image of any part of her person; as exemplified in the engraving, where the back of the lady's head is represented as reflected by the mirror, which the maid-servant has just shifted into a suitable position, in the opposite or central glass. Beneath the table there is a flap, which draws out in front for occasional use; and at back a sliding bag-frame, similar to those ordinarily attached to ladies' work-tables.

### EXPANSION OF STEAM.—MR. WATT'S CLAIMS.

Sir,—There appears to be but a minute point of difference between my opinions and those of "S. S." relative to the claims of Watt and Hornblower to the discovery of the principle of the expansion of steam, and this difference exists in the question—Did Mr. Watt *publish* his discovery antecedent to Hornblower's patent of 1781?

I am of opinion there cannot be any reasonable doubt of this, for I must maintain that the manufacture, erection, and sale of an engine "working on the expansion principle"* to a public company (the Shadwell Waterworks Company) in 1778, was, to all intents and purposes, a full publication, and would be so considered at the present time.

It cannot with fairness be said that I have indulged in any assumptions; the reasons I have given are simply historical facts, which may be found in the authors I have already referred to, and which I should as soon think of doubting, as that Hornblower's patent was dated in 1781, and Watt's in 1782, and, consequently, that the former was the first to *patent* the principle of expansion.

Nevertheless, most authors on the steam-engine are singularly deficient in their reference to the early works of Watt, after he had established the manufactory at Soho.

Farey, who perhaps may be considered the best informed upon this subject, mentions the Shadwell Water Works engine* (No. 1) as the *first* engine erected in the vicinity of London upon the expansion principle. This is incorrect. An engine was erected in 1776 for Cooke and Co., at Stratford-le-Bow; and in 1778 engines were erected at the Chelsea Water Works, at the Richmond Water Works, as well as at the Shadwell Water Works.

As it may be interesting to your readers, I will give the principal dimensions of each engine; and should there be any doubt of their accuracy, as coming from an anonymous correspondent, I will take care to prove their truth to you before this letter reaches their hands.† They are as follows:—

1776. Cooke and Co., Stratford-le-Bow.—Cylinder, 18 in. diam., 3 ft. 2 in. stroke; pump, 15 in. diam., 3 ft. 2 in. stroke; lift or head of water, 38 ft. Engine made 15 strokes per minute.

1778. Chelsea Water Works.—Cylinder, 30 in. diam., 8 ft. stroke; 16 strokes per minute.

1778. Richmond Water Works.—Cylinder, 18 in. diam., 3 ft. stroke; pump, 7½ in. diam., 84 ft. lift; and a lifting pump 7 in. diam.; each pump having 3 ft. stroke.

1778. Shadwell Water Works.—(Nos. 1 and 2) — Cylinder, 27 in. diam., 8 ft. stroke, 7 strokes per minute; pump, 10½ in. diam., lift, 180 ft. Both these engines expanded the steam ⅓ the stroke, or 2 ft. 8 in.

The second engine in this list, is that described by Farey, page 334 et seq., who saw it at work in 1804. He heads his chapter with the date of "1780," but in a note at page 336, he states it was erected at the Chelsea Water Works, *about* 1782. It was actually erected in 1778, three years before the date of Hornblower's patent. There was a peculiarity about this engine well worthy of attention,—it was worked by *two valves only*, the piston rising in *vacuo*. Very recently my attention was drawn to a modern engine of considerable excellence,

* This engine expanded the steam ⅓ of the whole stroke, or 2 feet 8 inches. (See Farey, 341; Galloway, vol. i. 319.)

* There were *three* engines erected at these works; *two* in 1778, and a *rotative* engine of 16 horses power in 1798.

† The writer has verified these particulars to our entire satisfaction.—Ed. M. M.

having this peculiarity, and which was supposed to be quite new!

All the engines here enumerated were worked with a quarter or less degree of expansion.

We cannot do better than request your opinion upon these questions—1st. Whether such public works could long remain a secret even in 1778?—2ndly. Whether they do not prove priority of discovery and use?—3rdly. What their probable effects would be upon a patent for similar purposes dated in 1781?*

Watt had overcome his principal difficulties before the year 1776, and sent out many engines in that and the two following years.

With reference to the questions put to me, I have to answer:

1st. I am not aware that the claims of Watt to priority of publication of the theory of expansion have been advanced, otherwise than by the general historians of the steam engine, who appear to have recorded facts only. That the friends of Watt did not raise this question, I consider to be no small evidence that they considered his claims just and undisputed, and therefore required no defence.

2nd. No experiments (as elucidating a principle) were made upon the Shadwell Water-works engine, nor upon any of the others I have mentioned. The necessary practical investigation into the principle of expansion had been completed at Soho in 1776, and its laws were established, as has been so well explained by Farey, and other writers upon the subject.

I beg it may be understood that I have not cast any reflections upon the memory of Hornblower, more than may be inferred by an establishment of the claims of Mr. Watt. I omitted all notice of Hornblower's *first* discovery of the principle of expansion in 1776, as given in "Gregory's Mechanics" for the precise reason given by "S. S." This evidence is far more slender than Mr. Watt's letter to Doctor Small in 1769.

In "S. S." I recognise an old and valued correspondent of this Journal, with whom I shall always be happy to enter the lists of fair and candid controversy. I do not shrink from the present discussion from any doubt of the justness of the cause I espouse, but I believe the subject to have been exhausted and the palm fairly given to Watt by the great majority of the mechanical world.

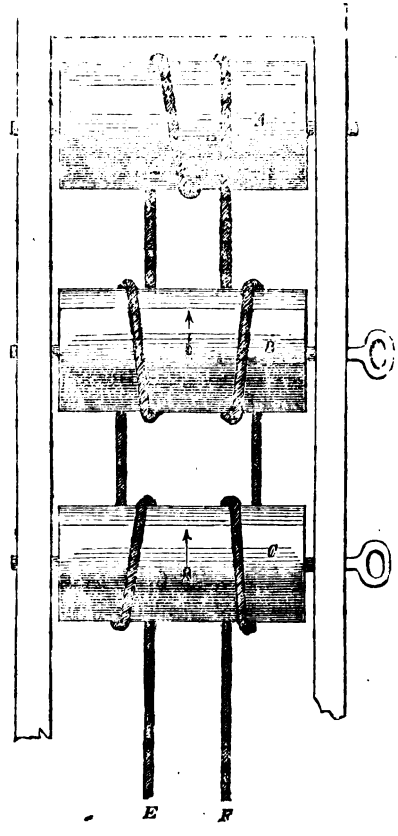
I am, &c.

PRESSURE NOT PUFF.

London, 10th Feb., 1846.

* We think there can be but one opinion on the subject: The facts adduced by our correspondent establish incontestably both a prior publication and use.—ED. M. M.

## KANGJAR ROPEMAKING.




Sir,—The problem involved in the passage quoted by your corrrespondent, "Inquirer," from Montgomery Martin's work on Eastern India in your last Number, ("*The Kangjar make ropes of the grasses called sabe and muj, they twist them by means of two cylinders turned by a string, first drawn one way and*

*then the other, but the cylinders always turn in the same direction,"*) may, I think, be perfectly solved in the manner shown in the accompanying figure.

If the string be moved round the cylinders, A B and C, in the way I have represented, and the ends of the string, E and F, be pulled, and slacked off alternately in a reciprocating manner, the cylinders, B and C, will always turn in the same direction. I have tried the experiment and found it answer completely. The solution is here given in its simplest form, though it will readily be perceived, that it admits of various modifications, and that the number of cylinders may be increased as far as the friction of the string will admit of. An ordinary grooved pulley may be substituted for the cylinder A.

I am not aware whether this mode of producing continuous circular motion from reciprocating rectilineal motion be familiar to European mechanicians or not, as stated. I do not recollect ever having before seen it, but think it probable that this, or something of a similar description, is what the passage alluded to refers. I have the honour to be,

Yours obediently,

J. S. TEMPLETON.

February 9, 1846.

### KANGJAR ROPEMAKING.

Sir,—If "Inquirer," of Newcastle, will go on board some of the colliers in the Tyne, I have no doubt he will see the Kangjar mode of ropemaking used there. It is *well* known and *much* used by sailors, but not known by the above title.

The reel, on which the yarn is wound after it is spun, has a pulley or groove at one end of it; and round this a turn of a small rope is made, one end being held in each hand: one hand is then wound towards the body and the other pulls the rope against the pulley until it has advanced as far as convenient. A considerable velocity is given by this means to the reel, when the rope is suddenly slacked and the hand put in the position first occupied: the reel still revolving receives another impetus, and the reciprocating motion of the hands is by means of the rope, or belt and pulley, converted into a rotary one. The principle is similar to a boy whipping a top, and is so simple—that it is difficult to describe!

R. S. N.

Gateshead, January 11th, 1846.

### FAIRER'S RAILWAY CLOCK.

Sir,—I had occasion recently, on business connected with a railway, to visit the offices of Mr. Pilbrow, in Bloomsbury-square, and as your pages are always open to receive communications and descriptions of useful mechanical inventions, I take the liberty of mentioning a very useful improvement I observed connected with the clock in one of the offices. It appeared upon inquiry that Mr. Pilbrow has no *interest* in the invention himself, but was the suggester of it to a clock manufacturer, (Mr. Fairer, of Tottenham.) As your readers may like to have a description of this simple construction I will briefly give one, and suggest, if I may, a still further improvement thereon.

I will first give an extract from Mr. Fairer's circular which he has issued upon the subject.

"*An improvement in clocks and time-pieces intended to be used on railways at their stations, and in towns and taverns on their route; being more especially adapted for such trains as run east or west.*

"The want of such an improvement has been long felt on such lines, and great inconvenience has been experienced in consequence by travellers, hotel-keepers, and others. As a line running from London east or west, keeping its own time throughout, in order to agree with London time, would differ from the *local* time very considerably at its extreme end, and more or less so at every intermediate station, it is consequently the source of numerous errors, inconvenience, and disappointments. What I have just stated was pointed out to me, and the simple method of completely meeting the objection suggested by a gentleman well known for his scientific knowledge, Mr. J. Pilbrow, C. E."

The clock, time-piece, or watch, is of the usual construction; but in place of the common minute, or long hand, there is placed a segment of a circle, corresponding in width to the greatest difference of time upon the line of railway in minutes. This segment is proposed to be of thin glass, consequently showing

the hour hand when it passes over it. Upon this segment is written, in plain and conspicuous style, the names of the places, such as the two extreme termini, and the place the clock is located, or, instead, the word *local*. For instance, *London*—Local—Exeter; thus, varyin these, and placing them as the distances from the proper time of each place, persons will always see, at a glance, the time for the locality, the time of railway, and time of extreme terminus.

I would further describe the invention in detail, but from fear of intruding too much on your valuable space. What I would suggest, as a still further improvement, is this—that the words or names of the places, such as London, Exeter, Local, should be so arranged on the segmental minute hand, that they would move upon a centre, or, being weighted, would keep their horizontal position, whatever situation the hand itself may be in, thus rendering it easier for reading at all times.

I am, Sir, your obliged servant,

T. WHEATLEY.

Brompton, Jan. 29th, 1846.

## ON NEW MAGNETIC ACTIONS; AND ON THE MAGNETIC CONDITION OF ALL MATTER.

By Professor Faraday.

[Being the substance of a paper read before the Royal Society, as reported in the *Philosophical Magazine* for February.]

The following is the order in which the several divisions of the subject treated of in this section of the author's researches in electricity succeed one another:—1. Apparatus required. 2. Action of magnets on heavy glass. 3. Action of magnets on other substances acting magnetically on light. 4. Action of magnets on the metals generally. 5. Action of magnets on the magnetic metals and their compounds. 6. Action of magnets on air and gasses. 7. General considerations.

In giving an account of the contents of this paper, any attempt to follow the track of the author in the precise order in which he relates the consecutive steps of his progress in this new path of discovery, would fail of accomplishing its object: for, by adhering to such a course, it would scarcely be possible to comprise within the requisite limits of an abstract the substance of a memoir extending, as the present one does, to so great a length, and of which so large a portion is occupied with minute and circumstantial details of experiments; or to succeed in conveying any clear and distinct idea of the extraordinary law of nature brought to light by the author, and of the important conclusions which he has deduced.

One of the simplest forms of experiment in which the operation of this newly-discovered law of magnetic action is manifested, is the following:—A bar of glass, composed of silicated borate of lead, two inches in length, and half an inch in width and in thickness, is suspended at its centre by a long thread, formed of several fibres of silk cocoon, so as to turn freely, by the slightest force, in a horizontal plane, and is secured from the agitation of currents of air by being enclosed in a glass jar. The two poles of a powerful electro-magnet are placed one on each side of the glass bar, so that the centre of the bar shall be in the line connecting the poles, which is the line of magnetic force. If, previous to the establishment of the magnetic action, the position of the bar be such that its axis is inclined at half a right angle to that line, then, on completing the circuit of the battery so as to bring the magnetic power into operation, the bar will turn so as to take a position at right angles to the same line; and, if disturbed, will return to that position. A bar of bismuth, substituted for the glass bar, exhibits the same phenomenon, but in a still more marked manner. It is well known that a bar of iron, placed in the same circumstances, takes a position coincident with the direction of the magnetic forces; and therefore at right angles with the position taken by the bar of bismuth subjected to the same influence. These two directions are termed by the author *axial* and *equatorial*; the former being that taken by the iron, the latter that taken by the bismuth.

Thus it appears that different bodies are acted upon by the magnetic forces in two different and opposite modes; and they may accordingly be arranged in two classes; the one, of which iron is the type, constituting those usually denominated *magnetics*; the other, of which bismuth may be taken as the type, obeying a contrary law, and therefore coming under the generic appellation of *diamagnetics*. The author has examined a vast variety of substances, both simple and compound, and in a solid, liquid, or gaseous form, with a view to ascertain their respective places and relative order with reference to this classification. The number of simple bodies which belong to the class of magnetics, is extremely limited, consisting only of iron, which possesses the magnetic property in an eminent degree, nickel, cobalt, manganese, chromium, cerium, titanium, palladium, platinum and osmium. All

other bodies, when either solid or liquid, are diamagnetic; that is, obey the same law, with regard to magnetic action, as bismuth, but with various degrees of intensity: arsenic is one of those that give the feeblest indications of possessing this property. The following exhibit it in encreasing degrees, according to the order in which they are here enumerated; namely, ether, alcohol, gold, water, mercury, flint glass, tin, lead, zink, antimony, phosphorus, bismuth. On the other hand, no gaseous body of any kind, or in any state of rarefaction or condensation, affords the slightest trace of being affected by magnetic forces. Gases may therefore be considered as occupying the neutral point in the magnetic scale, intermediate between magnetic and diamagnetic bodies.

The magnetic properties of compound bodies depend on those of their elements; and the bodies are rendered either magnetic or diamagnetic according to the predominance of one or other of these conditions among their constituent parts. Thus iron is found to retain its magnetic power, when it has entered into combination with other bodies of the diamagnetic class; the two forces acting in opposition to one another, and the resulting effect being only that due to the difference in their power. Hence the oxides and the salts of iron are still in a certain degree magnetic, and the latter even when they are held in solution by water; but the water may be present in such a proportion as that neither shall prevail; and the solution, as far as respects its magnetic properties, will then be exactly neutralized. These saline solutions, prepared of various degrees of strength, also afford a convenient method of comparing the relative degrees of force, both magnetic and diamagnetic, of different bodies, whether solid or fluid, but more especially the latter, as they admit of the body under examination being suspended in another liquid, when its position of equilibrium will indicate which of the two substances has the strongest magnetic power.

In one respect, indeed, the diamagnetic action presents a remarkable contrast with the magnetic; and the difference is not merely one of degree, but of kind. The magnetism of iron and other magnetics characterized by polarity; that of diamagnetics is devoid of any trace of polarity; the particles of two bodies of the latter class, when jointly under the influence of the magnetic forces, manifest towards each other no action whatever, either of attraction or repulsion. It has long been known that the magnetism of iron is impaired by heat; and it has been generally believed that a certain degree of heat destroys it entirely. The author finds, however, that this opinion is not correct; for he shows that, by applying more powerful tests than those which had been formerly confided in, iron, nickel, and cobalt, however high their temperature may be raised, still retain a certain amount of magnetic power, of the same character as that which they ordinarily possess. From the different temperatures at which the magnetic metals appear to lose their peculiar power, it had formerly been surmised by the author that all the metals would probably be found to possess the same character of magnetism, if their temperature could be lowered sufficiently; but the results of the present investigation have convinced him that this is not the case, for bismuth, tin, &c., are in a condition very different from that of heated iron, nickel, or cobalt.

The magnetic phenomena presented by copper and a few other metals are of a peculiar character, differing exceedingly from those exhibited by either iron or bismuth, in consequence of their being complicated with other agencies, arising from the gradual acquisition and loss of magnetic power by the iron core of the electro-magnet, the great conducting power of copper for electric currents, and its susceptibility of being acted upon by induced currents of magneto-electricity, as described by the author in the first and second series of these researches. The resulting phenomena are to all appearance exceedingly singular and anomalous, and would seem to be explicable only on the principles referred to by the author.

Pursuing his inductive inquiries with a view to discover the primary law of magnetic action from which the general phenomena result, the author noticed the modifications produced by different forms given to the bodies subjected to experiment. In order that these bodies may set either axially or equatorially, it is necessary that their section, with reference to the plane of revolution, be of an elongated shape: when in the form of a cube or sphere they have no disposition to turn in any direction: but the whole mass, if magnetic, is attracted towards either magnetic pole; if diamagnetic, is repelled from them. Substances divided into minute fragments, or reduced to a fine powder, obey the same law as the aggregate masses, moving in lines, which may be termed *diamagnetic curves*, in contradistinction to the ordinary magnetic curves, which they everywhere intersect at right angles. These movements may be beautifully seen by sprinkling bismuth in very fine powder on paper, and tapping on the paper while subjected to the action of a magnet.

The whole of these facts, when carefully considered, are resolvable, by induction, into

the general and simple law, that while every particle of a magnetic body is attracted, every particle of a diamagnetic body is repelled, by either pole of a magnet. These forces continue to be exerted as long as the magnetic power is sustained, and immediately cease on the cessation of that power. Thus do these two modes of action stand in the same general antithetical relation to one another as the positive and negative conditions of electricity, the northern and southern polarities of ordinary magnetism, or the lines of electric and of magnetic force in magneto-electricity. Of these phenomena, the diamagnetic are the most important, from their extending largely, and in a new direction, that character of duality which the magnetic force was already known, in a certain degree, to possess. All matter, indeed, appears to be subject to the magnetic force as universally as it is to the gravitating, the electric, the cohesive and the chemical forces. Small as the magnetic force appears to be in the limited field of our experiments, yet when estimated by its dynamic effects on masses of matter, it is found to be vastly more energetic than even the mighty power of gravitation, which binds together the whole universe: and there can be no doubt that it acts a most important part in nature, and conduces to some great purpose of utility to the system of the earth.

Towards the conclusion of the paper, the author enters on theoretical considerations suggested to him by the facts thus brought to light. An explanation of all the motions and other dynamic phenomena consequent on the action of magnets on diamagnetic bodies might, he thinks, be offered on the supposition that magnetic induction causes in them a state the reverse of that which it produces in magnetic matter: that is, if a particle of each kind of matter were placed in the magnetic field, both would become magnetic, and each would have its axis parallel to the resultant of magnetic force passing through it; but the particle of magnetic matter would have its north and south poles opposite to, or facing the contrary poles of the inducing magnet; whereas, with the diamagnetic particles, the reverse would obtain; and hence there would result, in the one substance, approximation; in the other, recession. On Ampére's theory, this view would be equivalent to the supposition that, as currents are induced in iron and magnetics, parallel to those existing in the inducing magnet or battery wire, so, in bismuth and other diamagnetics, the currents induced are in the contrary direction. As far as experiment yet bears upon such a notion, the inductive effects on masses of magnetic and diamagnetic metals are the same.

## BELL CASTING.

The casting of common house-bells or hand-bells differs in nowise from the processes relating to small castings in metal generally; but for church bells the case is otherwise. The production of a *sonorous* quality, in addition to many of those which pertain to all large castings in mixed metal, gives occasion for many scrupulous arrangements in the management of the foundry. There is only one such foundry in London, and very few in the country generally.

A bell-foundry must have a furnace which will contain many tons of metal, for the whole of the casting for one bell is made at once. In 1835, for instance, Messrs. Mears cast the new Great Tom of Lincoln, intended to replace the old Great Tom; it weighs 12,000 lbs., being somewhat heavier than the great bell of St. Paul's Cathedral; and the whole of this ponderous mass of metal was melted at one time and in one furnace. This Great Tom, though smaller than the bell of St. Paul's, is heavier, on account of its greater thickness.

The arrangements as to the central core or mould for casting a large bell are thus made:—Contiguous to the furnace is a pit, deeper than the height of the bell. In the centre of this pit is built up a rough mass of brickwork, somewhat smaller than the interior of the bell; and this is coated externally with a mixture of earth and horse-dung, applied in successive layers, and worked smooth by gauges, until the *exterior* of the core presents exactly the same size and shape as the *interior* of the intended bell. When the prepared core is thoroughly dried by means of fires, a second coating of composition is laid on of the same thickness as the intended bell; this coating, which is called the "model," is formed of earth and hair, and is, like the former, brought to a very smooth and correct surface by gauges, the exact counterpart of the exterior of the bell. A third coating is next applied, called the "shell," much thicker than the others, and formed of a somewhat different composition. A little tan-dust is sprinkled on the first coating, or core, before the second, or model is applied; and also on the latter, before the outer coating, or shell is laid on. When all is well dried, the "shell," is lifted off from the "model," and the model is picked or cut off from the core piecemeal. If we suppose the core, the model, and the shell to be three hemispherical cups placed one within another, and the middle one to be removed, it will serve to illustrate how a vacant space comes to be formed between the core and the shell: and when we further bear in mind that the exterior of the core gives the internal form to the bell,

and the interior of the shell the external form, the object of the whole arrangement will be clearly seen.

This internal cavity of the mould, between the core and the shell, is that into which the metal is to be poured. The casting-pit is filled up with loam or earth, to the level of the top of the mould; a shallow channel is cut in the loam from the furnace to an orifice communicating with the vacant space in the mould; and two other orifices are left for the escape of air as the melted metal enters. Meanwhile the metal is being melted in the furnace. The tin employed is in the form of blocks, brought from Cornwall; while the copper is old ship-sheathing and other fragments. These are melted in a reverberatory furnace, by the heat of billets of wood, a kind of fuel less injurious to the metal than either coal or coke. All being ready, the earth which stops an orifice in the lower part of the furnace is knocked or dug away, a narrow jet instantly pours out from the opening, and a stream of liquid fire (for so it seems to the eye) runs along the channel in the loam, and flows into the mould, bubbling and hissing, and giving forth greenish sparks. When the mould is full, the metal is allowed to remain till perfectly cool; the loam is then removed, the external "shell" lifted or cut from the bell, the bell lifted off the core, and the core pulled down. If the bell be very large, it alone occupies the pit; but if of smaller size, such as from three or four to ten or twelve hundredweights, six or eight may be cast in one pit at one time.

The tone of a bell depends conjointly on the diameter and the thickness; a small bell or a thick bell giving, relatively, a more acute tone than one which is either larger or thinner. Hence the founder regulates the diameter and thickness according to the musical pitch of the tone which the bell is to yield; but as this cannot be rigidly attained by casting only, the bells (say a set to form chimes) are attuned by chipping away some of the metal with a sharp-pointed hammer; reducing the diameter at the lower edge when the tone is too low, and reducing the thickness at the part where the hammer strikes when the tone is too acute.

While these sheets are passing through the press, the public journals announce the completion, by Messrs. Mears, of Whitechapel, of a bell intended for the south tower of York Minster. It is larger than any other in the United Kingdom, its weight exceeding twelve tons. It is seven feet seven inches in height, with a diameter of eight feet four inches. It is seven tons heavier than the "Great Tom" of Lincoln, and five tons heavier than the "Old Tom" of Oxford. The metal took twelve days to cool. The clapper weighs between three and four hundredweight. The cost is about 2000*l*.—*Penny Cyclopædia—Supplement*.

## FILE-CUTTING BY HAND, AND BY MACHINERY.

Files are indispensable for the working of all metallic and many other hard substances, and without their aid few articles of machinery could be produced. Holland observes that the use of the file must have preceded every step in the progress of finishing articles composed of iron and steel in all cases where any intricacy of shape precluded the operation of grinding. He considers that, great as is the antiquity of the revolving grindstone, the file must have preceded it, and refers, in confirmation of this opinion, to the passage in the first book of Samuel (chap. xiii. v. 21,) in which the file is mentioned as the means of sharpening the mattocks, coulters, and other edged instruments of the Israelites. He also refers to a passage in the Odyssey, in which Vulcan is represented as using the hammer and file in fabricating the net in which he entangled Mars and Venus, as a proof of the great antiquity of this tool.

Files always are, or should be, made of steel of superior quality, as there are few instruments in which a defect in the metal is so completely destructive of utility. An axe, saw, or almost any other cutting instrument, though of inferior metal, may be made to do its duty by repeated whetting; but for a bad file, as Holland observes, there is no remedy, —no process of restoration. "Let it," he says, "be too soft, and immediately on application the whole toothed surface of the file is crushed down, and ceases to be of any use for its intended purpose: if too hard, on the other hand, the teeth, so soon as they come into contact with the body to be acted upon, fly off with every stroke; the file thenceforward becoming, if not quite useless, certainly a coarse irregular rubber." The importance, therefore, of a guarantee of excellent quality gives a high value to files bearing the marks of manufacturers of established reputation, and leads unprincipled tradesmen to imitate them. "One of the most famous of these marks," Holland observes, "was that granted many years ago by the corporation of

Sheffield to Daniel Brammall; and as an illustration of its value may be mentioned the fact, that in 1825 the rightful user obtained a verdict of 2000*l.* damages against a Birmingham file-maker for having struck it fraudulently on articles made by himself."

Several highly ingenious machines have been contrived for superseding the tedious operation of file-cutting by hand, but we believe no file-cutting engine has been brought successfully into operation. One very serious difficulty arises from the circumstance that if one part of the file be either a little softer than the adjacent parts, or narrower, so as to present less resistance to the blow of the hammer, a machine would, owing to the perfect uniformity of its stroke, make a deeper cut there than elsewhere; "whereas," as Dodd observes, "a workman who has been employed in the trade from a boy (and none others, it is said, can acquire the requisite skill,) can feel instantly when he arrives at any variation in the quality or condition of the steel, and at once adapts the weight of his blow to it." Holland, after describing one of the machines contrived for this purpose, observes, that the applicability of such an apparatus to the toothing of extremely fine-faced files seems conceivable, because "in such the *set* or direction of the teeth is a matter of much less importance than perfect equality of surface;" thus intimating that a great difficulty arises in this apparently attainable point. "The double dead-cut files of the French," he adds, "exhibit such a beautiful uniformity of delineation when examined with a magnifier, that no doubt seems to be entertained, by many persons conversant with the art, of their being cut by machinery of some sort. But although the French are so successful in the production of this exquisitely delicate cutting, they are not equally so in the execution of the rougher sorts; and, consequently, English files are in high reputation in Paris, whither large quantities are regularly transmitted." This writer mentions a French manufacturer of watchmakers' files, some of which, cut in the common manner, but with exquisite neatness, by his daughters, were regarded with suspicion by many, simply from the opinion that they must be machine cut.

During the war of the French revolution, the supply of English files being impeded, the French file-makers were excited to great efforts to supply the deficiency, and, according to an article published in the "Repertory of Arts" for 1801, translated from the register of the French Lyceum, it would appear that a man named Raoul succeeded in producing files so hard that they would cut or abrade the best English files which, in a series of public experiments, were brought into competition with them.—*Penny Cyclopædia Supplement.*

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THE ROYAL STEAM NAVY.

Sir,—I have read with much pleasure a list of the steam navy, built, building or ordered to be built, in a late Number of your Magazine. Such data, generally so difficult to obtain, are most valuable, and I am sure you will be happy to avail yourself of any hint that you may receive that shall enable you to place before the public demonstrative proof that the present Board of Admiralty by an impartial distribution of contracts, are doing their utmost to stimulate all private contractors to enter the field of competition.

But the mere list of horse-power given to this, or that, engineer, including under *one* column a period of *four* years, will not enable the general reader to judge sufficiently of the impartial conduct of the present Board of Admiralty, who came into office but in 1841. You should publish at the same time, a list of all the iron steam ships which are building at the different factories; their burthen in tons, date of construction, &c. &c.; noting at the same time whether the parties are makers of engines as well as shipbuilders; your readers will then be able to perceive that their lordships strike the balance as fairly as possible, proportioned to the known resources of the several contractors; so that the party, who makes but a small relative proportion of horse-power when compared with a rival factory, has, from his being a builder of iron steam men-of-war, his equivalent in such contracts.

J. C. Hoseason, Commander R. N.
Army and Navy Club, February 12th.

[We shall endeavour, with the assistance of our engineering friends, (which we respectfully solicit) to supply the complete list which Mr. Hoseason suggests. —Ed. M. M.]

## REVIEW OF "LETTERS ON NAVAL CONSTRUCTION. BY CAPT. FISHBOURNE, R.N." BY LIEUT. W. GORDON, R. N.

The object of these "Letters" is to depreciate the sailing qualities of the vessels constructed by Sir W. Symonds,* the Surveyor of the Navy, and the course adopted for the purpose is; first, to misrepresent the actual performances of these vessels, and then to subject them to the test of theories which are quite incompatible with sound mathematical reasoning. To show where Captain Fishbourne has erred in point of fact, and how fallacious are his reasonings, will be the aim of the following remarks.

In page 6 of his Fourth Letter, there appears a Table containing the *weight* and nominal tonnage of the vessels composing the late Experimental Squadron, previous to their starting on the July cruise.

The first glaring error occurs in the column of "weight as per return." The *Queen*, (one of the Surveyor's vessels) is here rated at 1,996 tons. It appears, however, on referring to the foot note, that the above weight is NOT "as *per return*, but is the result of the author's peculiar style of arithmetical calculation; for he there admits, that the *return* of her weight gives 2,046 tons. From this he says he deducts 50 tons, to make up for the difference between the height of her midship port in July 1845, and its height when she sailed with Sir Edward Owen's flag in 1842, when, he says, her weights were 2,085 tons, and her midship ports 6 feet 2 inches, or 3¼ inches nearer the water than in July 1845. It is evident, that Captain F. has quite overlooked the additions to the *bow*, *stern*, and *keel*, of the *Queen*, which must have considerably increased her buoyancy, and nullified any ratio which might have otherwise been drawn between her displacement in 1842, and that of 1845. And the fact, has been stated to the writer of these remarks by an officer who was a lieutenant in the *Queen* at that period, is, that her midship port on the 2nd of March, 1842, was 6 feet 5 inches, instead of 6 ft. 2 inches.†

Captain Fishbourne concludes by observing, that "ships ordinarily become rather deeper than lighter." This will certainly not occur when a ship is built of comparatively new timber, and has been exposed for two seasons to a burning sun in Malta harbour.

But, at least, Captain Fishbourne should have given the official returns of weight from Sir W. Symonds' ships as much credit for correctness as those of the other vessels, the weights of *Superb* "per returns," being 1,841 tons, instead of 1,823.

Having shown by these returns, that the rated tonnage of Sir W. Symonds' vessels is much superior to their actual burthen, (being, in fact, a fictitious number,) Captain Fishbourne, proceeds to give them *credit* for it, and in support of his argument, adduces the case of yachts-men, who, he says, "have the stern posts of their vessels raked to an injurious degree, in order to obtain, *great actual*, with *little nominal* tonnage, that they may be permitted to compete with vessels of a limited amount of *nominal* tonnage." By comparing the words in italics with Captain F.'s attempts to prove the value of the great *nominal tonnage* which is possessed by Sir W. Symonds' ships, it will be observed, that his argument is most amusingly directed against his own position—for the greater *extreme beam* of Sir W. Symonds' ships, unfortunately, gives them what yachts-men are most anxious to avoid; viz., *great nominal tonnage* with little *real tonnage*.

In page 8, Captain F. becomes rather obscure in his meaning; for it would appear, from the following extract, that in ordinary circumstances the Surveyor's lines are (in his opinion) the best for fast sailing. Then, after proposing that the *Rodney's* lines should be *fine* below, he proceeds—

"The area of her water-line would have been increased, and her stability with it; thus, in every point she would have been better to have had less displacement. Thus, the fact of the Surveyor's vessels having less displacement in proportion to their

* Queen, Superb, Vanguard, Albion.

† Captain Fishbourne seems to have forgotten that in 1845, the *Queen* stowed about 70 tons more water than she could possibly do in 1842, when her magazine was amidships.

tonnage than the old vessels, is an advantage in sailing under ordinary circumstances, rather than a disadvantage."

We now arrive at the most unsound and unfair portion of Captain Fishbourne's theory, which, totally regardless of the simplest laws of ratio or proportion—assumes that the *velocity* of sailing vessels under trial together, should be in the *direct ratio of their motive power* or area of canvass divided by the weight they carry—in conjunction with a purely *theoretic* gauge of merit—which is obtained by dividing the *nominal* tonnage by the *number* of guns! The last terms of these conditions are, if possible, more ridiculous than the first. For if the former neglect the important law that the velocity of a *sailing vessel* varies as the *square root* of the motive power, or area of canvass, (*cæteris paribus*)—the latter rest upon the equally absurd assumption that *all* the guns in the navy are of the same *weight!* It is almost superfluous to state, that although the *Queen* mounts but 110 guns, and the *St. Vincent*, 120; yet, the gross *weight* of the guns, carriages, and gun gear of the *Queen*, is equal to that carried by the *St. Vincent:* and whilst the latter vessel includes fourteen carronades in her upper deck armament, whose gross weight (with six long guns,) amounts to 626 cwt.; the *Queen* mounts 20 *long guns* (in the same battery,) whose weight amounts to, 752 cwt.! Again, the *Superb*, mounts 80 guns, whilst the *Canopus* mounts 84; but their gross weight in the *Superb* amounts to about 25 tons *more* than in the *Canopus*—the disparity being caused by the substitution of *long* 32-*pounders on the upper deck of the Superb*, for the pop-gun carronades of the *Canopus*.

Capt. Fishbourne's theory is so thoroughly opposed to correct reasoning, that it may be as well to transcribe it entire from his own pages.

"Of course then, in comparing these vessels with the *Queen* and each other, it will be quite fair to allow each an equal amount of tonnage to a gun, or at least to make an allowance for any deficiency in this respect, and thus so far reduce all to a common standard. This may be effected by *dividing the number of tons admeasurement of each ship by the number of guns carried by that ship*, taking the quotient as one portion of her theoretic number."

Then follows this extraordinary announcement:—

"It would seem hardly necessary to say, that under similar circumstances of weather, wind, &c., *equal weights ought to be moved at equal speed, by equal motive power;* and if it prove not to be so, it must be because either of the vessels carrying these weights, is of a form less adapted for speed than the other; but as the motive powers of some of the ships is greater than that of others, while their weights are less, an allowance must be made for the difference; this I propose to effect by dividing the number of feet area of sail (or motive power) by the number of tons weight carried, and take the quotient as the other portion of the theoretic number, a comparison of which number for each ship will give an approximate comparative value of their respective forms in regard to speed, &c."

In the note appended to these assertions, Captain Fishbourne seems to be aware, that a press of sail is not at all times so great an advantage as his *theory* takes credit for; in fact, he does not hesitate to record on the same page, "That he has known a ship to go faster after reefing," and the evil of carrying a fore-top gallant sail too long—whilst in page 18, he asserts that the *Rodney* gained *very considerably* upon the whole squadron when her *fore-top gallant sail* was again set after the yard had been carried away and shifted! It will naturally occur to the reader, "What reliance can be placed on the theories of one who propounds such palpable contradictions on behalf of a favourite vessel, and in depreciation of a rival?"

The obvious spirit of partisanship in which Captain Fishbourne writes, has caused him to commit another error with regard to the acknowledged rules of rival shipsailing; when he takes credit for the extra dead weight of ballast carried by the *St. Vincent*, *Rodney*, and *Canopus*. If Captain F. had sufficiently studied his subject, the Experimental Brig Squadron of 1844, would have afforded him ample proof, that authorities, who may be considered as good judges as himself, have determined that the terms of an equal competition between vessels of

war, will be fulfilled, when each vessel under trial possesses equal quantities of motive power, with equal *weights* of *armament*, *provisions*, *and* men; whilst the amount of *ballast* is left to the discretion of the constructor, and in the trials alluded to, varied from about 60 tons in the *Daring* to 9 or 10 in the *Espiegle*. To an unprejudiced mind the justice of this arrangement is evident, for ships of a certain construction could no more sail without their ballast than without their masts, and it is absurd to carry to the credit of their *sailing qualities* a dead weight whose presence alone enables them to come into the field with any chance of success.

But we may safely give Captain Fishbourne credit for the *St. Vincent's* and *Canopus'* extra weight of ballast, by drawing his attention to the fact that the weights *received on board* of any vessel do not constitute more than *half* of the *total* weight to which the motive power of the sails is applied. It will surely not be denied that the *vessel itself* is at least of equal importance in the discussion, with the weights which are received on board; and *its* own weight is equal to that with which it is burdened. The hulls of the *Queen* and *St. Vincent* may be considered as equal, and amounting to 2240 tons; consequently the gross weight propelled by their respective motive powers will be 2240 + 2230 = 4470 for *St. Vincent*, and 2240 + 2046 = 4286 for *Queen*.* The reader will at once perceive the difference between the ratios of 2046 : 2230 and 4286 : 4470. The same will be true in the comparison of the *Superb* with the *Canopus*, but probably in the *Superb's* favour; for it may be taken for granted that her hull, from her greater beam above water, is heavier than that of the *Canopus*.

It is *not* fair to infer that the *Rodney* labours under a greater disadvantage, and that her theoretic number should be lower than that of the *Canopus*, in consequence of the additional weight which she carries with the same motive power. The reverse may be proved by many arguments:

1st. The area of her midship section and direct resistance are certainly not greater than in the *Canopus* and *Superb*, and the extra displacement caused by her *excess of weight*, is included in her *excess of length*, which is 12 feet more than that of the *Canopus* and 15 feet more than the *Superb's*.

2nd. Her motive power being the same, the wind will act more favourably upon her sails owing to her masts being further apart, in consequence of her increased length.

3rd. The *Rodney* has more than *double the depth of keel* compared with the *Superb*.

Thus it appears that compared with these ships she possesses the *same* direct resistance, much more *lateral* resistance, *superior* motive powers, and yet in spite of these advantages she only proved *equal* to the *Canopus* upon the August cruise, and very inferior to both the *Superb* and *Canopus* in the November cruise. Will it be asserted either, that the *Rodney* or *Canopus* would be improved by heavier spars and larger sails, when the *Rodney* is taken into dock for the purpose of increasing her stowage of water *by* 100 *tons* with the view of *improving her sailing qualities*. If as Captain F. asserts, she laboured under a disadvantage in carrying more weight, why add to it? or why *not* increase her motive power? or why propose* an additional 40 tons of ballast?

The *Rodney's* sailing qualities are dependent on her superior length; any ship may be improved in *speed* by length, but she will not work so easily. In the November cruise, when trying under treble-reefed topsails, the *Superb tacked with ease*, whilst the *Rodney* missed stays in making the attempt.

Captain Fishbourne does not allude to a

* On referring to the official returns, (April 10, 1845,) the *Queen's* constructed load line displacement is stated to be 4,476 tons, and the *St. Vincent* 4,482. In the published return prior to the sailing of the squadron in *July*, the displacement of the *St. Vincent* is stated to be 4,484 tons, and that of the *Queen*, 4,405. At this period the two vessels appear to have had equal weight on board, with the exception of ballast, of which there must have been, at least 200 tons more in the *St. Vincent* than in the *Queen*. From the above data, it appears that the weight of the *Queen's* hull is at *least* 120 tons more than the *St. Vincent*—the whole of which excess is above water.

* The *St. Vincent* had originally the masts and yards of the *Queen*, but she was considered to be unable to carry them.

great disadvantage which the Surveyor's ships labour under in comparison with the *St. Vincent* and *Canopus*; the *Queen* being one foot shorter than her rival, and the *Superb* 3 feet shorter than the *Canopus*. The only advantage which increased beam can give in sailing, is superior stability and easier *longitudinal* motion; whilst in a *seaway* it opposes a greater direct resistance to adverse wind and sea, with the disadvantage of increasing the moments of the guns in the *rolling motions*; yet notwithstanding this, we are prepared to prove that on the August and November trials, which occurred in fresh breezes and head-seas, the more these supposed disadvantages predominated, the more decisively did the *Superb* beat the *Rodney* and *Canopus*.

Captain Fishbourne appears to rely implicitly upon Lieutenant Ryder's observations, for the correctness of his data; an equal degree of correctness may at least be claimed for the observations obtained on board the *Superb*, where (it may be remarked) the same method was pursued as that on board the *Rodney*, although Lieutenant Ryder appears to think (*Nautical Mag.* for Nov.) that it was something new. Notwithstanding the assumed infallibility of the results obtained on board the *Rodney*, we must point out a very *material error*, and a *more* material omission, which occurs in Lieutenant Ryder's published account of the July and August cruise. The *error* occurs in the account of the trial in a *fresh breeze* and much *head-sea*, on July 28th, when it is stated that the *Superb* was beaten by the *Canopus* and *Rodney* between 10 a. m. and 1·50 p. m.; but Lieutenant Ryder acknowledges that "This does not agree with the apparent positions of the ships *just before* the shift of wind, nor with the opinion *generally expressed by the officers, who thought the Rodney was beaten by all the ships.*" "He can attribute this difference only to the shift of wind during the day."

These remarks will sufficiently explain the origin of the unfair estimate of the *Superb's* performance. The fact is, nothing could be correctly determined after *twelve o'clock*, when the wind first shifted, and the headmost ships were ordered to tack.

On board the *Superb* the trial was considered as *terminated* at this hour, the *Canopus* being then *beaten* by 210 yards, and the *Rodney* by 1250; and at 1·30 p. m. the *Superb* crossed to windward of the *Rodney* by 2550 yards, and of the *Canopus* by 462 yards.

The omission which Lieutenant Ryder has made, is the account of the *forenoon trial* on *July* 30th which lasted for 1¼ hour in the *strongest breeze* and *heaviest head-sea* which occurred during the cruise. On this occasion the wind was steady (during the trial) and the *Superb* weathered on the *Rodney* by 400 yards, or at the rate of 330 yards per hour; and passed to windward of her, close enough to compare the *Rodney's* heavy plunging (by which her main top gallant bowline was carried away) with her own easy motion. On this trial the *Superb* beat the whole squadron; but the *St. Vincent* being some miles to windward and obscured by thick weather, has afforded a *plausible* though not a *sound* reason for its omission.

On July 31st, (the third trial in a fresh breeze) the *Vanguard* proved equal to the *Canopus*, and the *Superb* to the *Rodney*, the wind having gradually died away.

On August 19th, in the fourth and last trial in a fresh breeze, the *Vanguard* beat the field, and the *Superb* was beaten by the *Rodney*, and about equal to the *Canopus*; but no dependence can be placed on this trial as the vessels did not tack together; and by referring to the *Nautical Magazine* for October and November, it will be seen that a wide discrepancy occurs between the accounts of Lieutenant Ryder and those of "an officer of the St. Vincent," who represents the *Superb* to have beaten the *Rodney* by 2 yards; whilst the *Rodney* claims a distance of 1930 yards in her own favour.

With respect to the *Queen*, it may be stated that she *never* tried with the *St. Vincent* in a fresh breeze and sea close hauled; but on the 19th of August she beat

the *Trafalgar* between 800 and 900 yards in about three hours.

The above facts fully disprove the assertion, that in fresh breezes and a seaway the Surveyor's ships are invariably beaten; whereas it has been clearly proved, that in *July and August*, during the only four trials which occurred in this description of weather, either the *Albion*, or *Superb*, or *Vanguard*, was the fastest and best ship upon the occasion.

With regard to the performance of the Surveyor's ships on the October cruise, it may be observed that Sir Samuel Pym's report will be deemed by many quite as worthy of credit as Captain Fishbourne's deductions from his *theoretic numbers*.

In the November trials the *Superb invariably* beat the *Canopus* and *Rodney*; and an instance of misrepresentation on this head occurs in p. 25, where the *Superb* is stated to have beaten the *Canopus* only 250 yards in a run of 70 miles; but the fact is, by the observations on board the *Canopus*, the *Superb* was estimated to have beaten her by 1100 yards on this occasion. It is *not* a fact that the *Superb* had "200 tons less weight" than the *Canopus* on these trials, which will be proved by the following statement:—

In July, the weights on board of the *Superb* and *Canopus* were, by the official returns precisely similar (1841 tons,) and the only weights which were removed from the *Superb* in October were 92 tons of water, and 14½ tons weight of tanks, being a total weight of 106½ tons; and as both ships would consume an equal weight of provisions, &c., it is clear that the weights of the *Canopus* were only 106½ tons more than the *Superb's*, with this great advantage in favour of the former, that *she* had 120 tons *more ballast*, and 25 tons *less weight of guns* than the latter.*

In four trials which took *place off the wind* on the last experimental cruise, the *Superb* beat the *Canopus* 6400 yards, and the *Rodney* 12,110 yards, in the course of eighteen hours' trial, or at the average rate of 350 and 670 yards, respectively *per hour*. In the *third* trial with the wind, a little before the beam, and steering *directly against a heavy head-sea*, the *Superb* beat the *Canopus* at an average rate of 300 yards per hour, and the *Rodney* at a rate of 1200 yards per hour. In *every trial* on a wind, the *Superb* beat the *Canopus* and *Rodney*; and the most decisive trial with the *Canopus* occurred on the 21st of November, in a *strong double-reefed topsail breeze* and head-sea, when the *Superb* beat her 2260 yards dead to windward in the course of 3½ hours; the rate of sailing being from seven to eight knots. In this trial the great instability of the *Canopus* was very apparent, and she was compelled to furl the main-top-gallant sail at least an hour before the *Superb*.

It was remarked, that on every trial in a *head-sea* the *Superb* fore-reached considerably, except when the wind was *light* and variable. Her superior *easiness* has always been remarkable, especially in *pitching* and *scending*; and the strongest proof of this assertion is the fact, that *not a single laniard of a lower shroud, or bobstay, has been touched* since her return from a six weeks' cruise in the Bay of Biscay, during a constant succession of gales.

A gross falsehood appeared in the *Morning Herald* respecting this ship's topmast rigging, which was asserted to have been *new* when supplied to her; it was, however, the *same* which was placed over the mast-heads of the *Vanguard* on fitting out in 1840, and had consequently been exposed to the weather in that ship for a whole commission. When refitted by the Dockyard for the *Superb*, the *eyes* had not been *seized in* at the old mark, which was an additional reason for its condemnation.

In p. 14 it stated, that the *St. Vincent pitched* to 10°, but *scended* to only 1°. It appears difficult to credit such an assertion as this.

In p. 18, it is stated that the "*Rodney's* form must be a comparatively good one, to have effected what she has; for no ship was sailed under so many disadvan-

* The *Superb* must have taken on board considerably more than five months' salt provisions in June; having upwards of two months' remaining on board at the end of December.

tages. 1st. Her magazine is amidships, and *thus the heavy weights are thrown more towards the extremities, but especially forward*, where she could least bear it."

This is very incorrect. Every one who has been on board of vessels fitted with a *midship magazine*, such as the *Rodney*, *Albion*, or *Vanguard*, must have remarked the immense space occupied by their store-rooms, which extend from the bulkhead of the *coalhole* to the *stem*. Can it, then, be believed that building a magazine in this vacant space (which, with its powder, would weigh upwards of *thirty tons*) will have the effect of removing "heavy weights from the extremities, and especially from forward?"

The second disadvantage, it appears, consists "in having been *designed to carry greater weights*, and now sailed light of this quantity, by which her centre of gravity is raised, and her stability decreased."

On comparing this passage with former ones, where the *Rodney's superior* weight is complained of, it is difficult to discover how their consistency can be reconciled. It would be a waste of time to take notice of the remaining disadvantages under which the *Rodney* is said to have laboured, but all mention is studiously omitted of her *advantages*, such as depth of keel,* length, and distance between her masts.

In p. 19 allusion is made to the very "great advantage" possessed by the *Queen* over the *St. Vincent* "in having received 260 square feet of vertical longitudinal area;" but it appears, on Captain Fishbourne's own showing, that before she received this addition, the *St. Vincent* was superior in this respect by 206 square feet, consequently the *Queen's* "great advantage" must be reduced from 260 to 54 square feet.†

In p. 23 allusion is made to the *Espiegle* and *Flying Fish*. The *scientific* ship-builders had a fair opportunity in the construction of the *Espiegle*, of proving the value of their system, which is so loudly boasted of. But what were the results of the two experimental cruises with these vessels? It is true that the *Espiegle* floated to within an inch of the calculation, and her constructors are entitled to all the praise which would be due to them, if by this qualification she was enabled to overhaul every chase; but, on turning to the reports, it will be found that on the first cruise the *Flying Fish* beat the *Espeigle* seven times out of eleven, and a distance of 8468 yards; and their second cruise produced similar results; the *Flying Fish* again beating her seven times out of eleven, and a distance of 8400 yards. It was also remarked that the *Espiegle* could not stand a head-sea.

In p. 26 it is said, "the *St. Vincent* has a greater proportionate number of guns to tonnage than the *Queen* by twenty-seven, *which with their tackling are all situated high*, and must therefore reduce her stability considerably." It has already been shown that the weight of the *Queen's* guns, &c., is equal to the *St. Vincent's*; and the *Queen* carries not only a much greater *weight* of guns on her *upper-deck*, but likewise the same *number* as the *St. Vincent*, and her midship lower-deck port was $4\frac{3}{4}$ inches higher from the water.

In p. 36 it is stated, "that when fair, nay even necessary allowance was made, that then they (ships of the old construction) proved themselves superior during the cruise under Admiral Parker." The following specimen of what Captain Fishbourne proposes as a "fair and necessary allowance" is perhaps the most glaring instance of his general want of correctness. The *Queen's* theoretic number is said to be 57·84, whilst the *Rodney* is only 56·16.

One portion of these numbers is obtained by dividing the feet area of sail by the weights, and multiplying the quotient by 2. Thus, according to Captain Fishbourne,

$\frac{29500}{1996} = 14{\cdot}87 \times 2 = 29{\cdot}74$ for the *Queen*,

and $\frac{28100}{2001} = 13{\cdot}98 \times 2 = 27{\cdot}96$ for the *Rodney*.

* *Two feet eight inches*, or about three times as deep as the *Superb's*.

† In the same page (19) it is stated that before the *Queen* was altered she was "very much more weatherly" than the *St. Vincent*; but it appears that in 1844 (before the alteration) the *St. Vincent* only beat the *Queen* 2560 yards, to windward, in the course of twenty hours' trial.

Now by the official returns of displacement, it appears that the *real weights* moved were, *Queen* 4405 tons, and *Rodney* only 4142 tons; therefore, according to Captain Fishbourne's fallacious theory,

$\frac{29500}{4405} = 66{\cdot}9$ for *Queen*, and $\frac{28100}{4142} = 67{\cdot}8$ for *Rodney*. It would be a waste of time to proceed further in the calculation, but enough has been shown to prove that Captain F.'s attempts to depreciate the sailing qualities of the Surveyor's vessels have signally failed, and can only convey to the reader an impression of his manifest violation of the simplest mathematical rules.

The actual order of merit which the vessels occupied on the first experimental cruise is, according to Lieutenant Ryder:—

| | |
|---|---|
| Queen | 61·26 |
| Albion | 57·40 |
| Rodney | 56·16 |
| Canopus | 55·84 |
| St. Vincent | 53·78 |
| Trafalgar | 53·22 |
| Superb | 50·85 |
| Vanguard | 49·30 |

It appears, however, that in this account, besides errors, two trials *are omitted* in which the *Superb* signally beat the *Rodney* on a wind. The trials alluded to occurred on July 21st and July 30th, a.m., and the effects of their results if admitted into the table (p. 10) even on the same incorrect and unfair terms as the other would be, to increase the *Superb's* actual number from 50·85 to 52·20.

In Captain Fishbourne's first Letter, he stated positively that the *Queen's* bow had been altered on a wrong principle; and in subsequent letters it is insinuated that her superior performance after the alteration must be due to the increase of keel. How far these assertions are correct will be proved by comparing the performance of the *Queen* and *St. Vincent*, both before and after the alteration. There can be little doubt as to the correctness of the results of trials *off the wind;* and by a comparison of those which took place in November, 1844, and July and August, 1845, it will be clearly proved what a vast superiority the *Queen* had obtained; although she had increased her stowage of water by nearly 100 tons, and her additional keel can hardly be said to have increased her velocity.

In three trials off the wind, which took place in 1844, the *St. Vincent* beat the *Queen* 8·28 miles in the course of nineteen hours, or at the average rate of 0·43 miles per hour.

In three trials off the wind, which took place in July and August, 1845, the *Queen* beat the *St. Vincent* at an average rate of 1500 yards, or 0·75 miles per hour. The cause of this vast difference must have been the improvement in the *Queen's* bow, and quite disproves the assertion that the alteration in the bow was effected on a wrong principle. Apart from theoretical considerations Captain Fishbourne appears to found his preference for the hollow bow on Mr. Russell's experiments; but he has quite overlooked the fact that its superiority was only proved in the *water lines* of vessels having a *light draft*, and cannot be applicable to the lower portion of the bow of a line-of-battle ship. It has also been practically proved that after a bow has been sharpened so as to form an angle of about 20° with the keel, no further decrease of angle will materially diminish the resistance; and this is the reason why the long bow is superior to the hollow bow. Although, therefore, the *wave form*, or hollow bow, may be applicable to the *surface water lines*, where the angle of the bow is large; it will not maintain its superiority when applied at much lower depths.

Captain Fishbourne takes exception to the superior beam of the Surveyor's vessels causing the angle at the bow to be too large. At the *water line* it would seem necessary, that the angle of the bow should be in the proportion of the respective breadths, or as 56 to 52 (in 80 gun-ships,) which is certainly not a very great disproportion; whilst it must be remembered that in most parts of their section, Sir W. Symonds' vessels have *less beam* than the old ones.

The *mean angle* of the bow will therefore be probably less, instead of greater; and

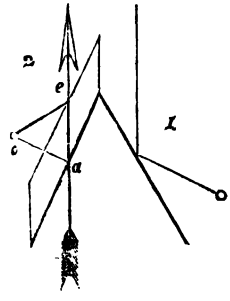
there is considerable looseness of argument when speaking of the "angle of bow," to allude only to that portion which is cut by the water line.

Another palpable *theoretical* error which Captain Fishbourne has committed, occurs in his third Letter, where he asserts that a vessel moored in a stream and one in the course of propulsion, are not under similar circumstances with regard to the relative motions of the vessel and the fluid.

He proceeds to prove his point by showing that when a billiard ball is projected against a plane, the angle of incidence will be equal to the angle of reflection, but "where a plane moves along a given line and strikes a billiard ball, it will project the ball in a direction perpendicular to its surface." Water, he further states, will be similarly acted upon.

In the first case, Captain Fishbourne has recognised the *momentum* of the *ball* or particle; whilst in the second case, he has totally overlooked the *momentum* of the *plane*, or bow of the vessel. A vessel moving through the water, in due time obtains a continuous motion, and is not stopped short at every particle which she encounters; yet, this result must take place before Captain F.'s new theory can hold good. If the plane should be *instantly stopped* on touching the billiard ball, it would undoubtedly be projected in a line at right angles to the surface; but if in the one case, the *ball* is supposed to continue in motion after striking the *plane*, it must likewise be conceded, that the *plane* will continue in motion after striking the *ball*. The plane must therefore be supposed to advance as far as the ball is projected in equal portions of time, and if a line be *then* drawn from the point of concussion to the ball, it will be found, that in both cases the *angle of incidence is equal to the angle of reflection*.

Figure 1 represents the ball striking the plane. In 2, the arrow represents the direction in which the plane moves, or course of the ship. It strikes the ball at the point *a*, and it will be seen, that the point of concussion arrives at *e*, whilst the ball is projected with equal velocity to *c*,




and the line *b c* will represent the true *relative* motions of the *plane* and the *ball*.

In Captain Fishbourne's diagram it is assumed that the point of concussion in the plane *stops short* at *a*, and that consequently, the path of the ball is *a c*. In the application of this new theory to the motion of a ship, can Captain Fishbourne really suppose that a vessel going (say) six knots against a tide which runs with equal velocity over the ground—does not experience precisely the same resistance as if she were going at the same rate in still water? And yet, in the one case, the ship would be *standing still in relation to the earth* (like the plane struck by the ball,) and in the other case, the *water* would be motionless *relative to the earth*, (like the ball struck by the plane.)

Or does he suppose that the strain upon a tow rope and all the motions of the fluid are not precisely similar when the ship and water have similar relative velocities, whether she is drawn by it in a tide way, and motionless with regard to the earth, or drawn by it with equal velocity through still water?

In page 22 of his third Letter, Captain Fishbourne alludes to the "causes of the failures in our war steamers designed by Sir W. Symonds," which require "great power to drive them;" as assignable to their faulty construction. He seems to be unacquainted with the real causes of the higher powers being adopted in spite of the opposition of engineers; and if he should hereafter compare the performance of the *Terrible* with that of the *Retribution*, it must be borne in mind, that although of *nominally* equal

powers, the *Terrible* works under a *higher* pressure by 4 lbs. than the *Retribution*, whilst the boilers of the *latter* (when filled for use,) weigh upwards of *one hundred tons* more than those of the *Terrible*.

In conclusion, it may be observed, that the *data* on which the preceding strictures are founded have been nearly all taken from Captain Fishbourne's own pamphlet; so that he may in a manner be considered as self-refuted and self-condemned.

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### THE CAMBRIDGE EUCLID.*

Another Euclid! Ay, an unmutilated edition of old Simpson from the Cambridge press, and the first that has been professedly edited by a Cambridge man! This is symptomatic of a change, which few persons would have, seven years ago, anticipated, in the character of Cambridge studies; and we augur well from this and one or two other recent publications, of the returning good sense which directed the mathematical studies of that university a century ago. It is not, however, our present business to discuss university systems; to compare the relative advantages of the geometrical and symbolical methods of developing mathematical truth; or even to inquire which is the most conducive to the cultivation of the reasoning faculties and the ready appreciation of a valid argument; no, nor yet to question which most contributes to the supply of the larger wants of mathematical knowledge in professional pursuits:—our business is with the book before us, and with its comparative adaptation to its proposed objects.

Cambridge never has stood high in reputation for the cultivation of the ancient g ometry, such as that of Euclid and Apolk ius; but from the time of Barrow and of N wton, the cultivation of a certain amount o the geometry which stands midway bet en the ancient geometry and the modern a lysis, has been earnestly insisted on by the successive syndicates of the University—the methods developed in the *Principia* being taken as the general model. More recently, that is within the present century, there has been a growing desire to emulate the foreign analysts in the peculiar course of mathematical development, which had sprung up during the preceding century; and for the last thirty years this desire has been allowed to expand itself with the most unobstructed vigour and luxuriance. Every chance and every encouragement have been given for the ardent analyst to disport himself in the shadowy regions of symbolical mystification; and numerous attempts have been made to strike out new views, to effect new combinations, and to make new applications of the symbolical playthings of the Gallic school. It has, however, proved to be a toy that does not comport with an English gymnasium; and it will be impossible to point out any one great discovery made by Cambridge men by the aid of "the modern analysis." Even Cambridge itself is growing weary of its toy; and the more rational thinkers in that university are now convinced, that the *sole* cultivation of these methods is not only at war with the best interests of a public of growing intellect, but also with the specific and vested interests of the governing body itself. To prove that our statement rests upon ample authority, we shall give one quotation from a recent work, the production of no less competent a judge than Dr. Whewell, the Master of Trinity College, Cambridge. See his work entitled, "Of a liberal Education in general; with particular reference to the leading studies of the University of Cambridge, 1845," pp. 61—2.

"For (to add one more to the points of advantage of geometrical over analytical forms of mathematics for common educational purposes,) it will generally be found that a person who has studied the branches of mathematics, in the more special and detached forms in which they were treated geometrically, before analytical generalities became so common, will be able to apply his knowledge to the calculation of practical results, and the solution of problems, better than a person who has acquired his mathematical learning under general analytical

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* Euclid's Elements of Geometry, chiefly from the tract of Dr. Simson, with Explanations, Notes, &c. by Robert Potts, M.A., Trinity College, Cambridge, 1845.

forms. The geometrical student has a firmer hold of his principles than the analytical student has. The former holds his fundamental truths by means of his conceptions; the latter by means of his symbols. In applying doctrines to particular cases, or in solving new problems, the former sees his way at every step, and shapes his course accordingly; the latter must commit himself to his equations; which, except he be a consummate analyst, he will not readily understand and interpret in their particular application. I have no doubt that in any application of geometrical, mechanical, or hydrostatical principles to a problem of moderate difficulty, supposing the problem new to both of two students; one a geometer of the English school of forty or fifty years back, the other, a modern analyst, instructed in equal degrees; the former would much more accurately and certainly, obtain a definite and correct solution. In the application of mathematics to problems of engineering and the like, the generalities in which the analyst delights are a source of embarrassment and confusion, rather than of convenience and advantage. When particular problems are solved by particular considerations or particular artifices, the ingenuity thus exercised is a talent really more generally available than a knowledge of the general methods which express all problems alike, *but actually solve none.*

"From the considerations which have thus been stated, I am led to the conclusion, that the geometrical modes of treating the various branches of mathematics are those which are to be employed as educational studies. The geometrical forms of trigonometry, conic sections, statics, and dynamics, and not any analytical substitutes for them, must be parts of a liberal education. This must be so, because, thus alone can mathematics be an intellectual discipline, strengthening the reasoning powers for other more mathematical occupations; thus alone can the mathematical sciences be known in that historical shape with which a liberally educated person ought to be acquainted; and thus best is a person of moderate mathematical attainments able to apply to practical cases the knowledge which he possesses."

The methods of investigation furnished by the antient geometry, by the ordinary algebraic processes, and by the use of the trigonometrical formulæ, have hence some chance of obtaining attention and inspiring respect, amongst us; since the example of constituting these the fundamental portions of mathematical acquirement is set us by the University of Cambridge itself. We say then, that we augur well for the future from the indications of the present: and it is with no ordinary satisfaction that we see in the edition of Euclid by Mr. Potts, the earnest spirit in which these views are followed out by persons of educational influence in that University.

It will strike our readers, that to give a new and unmodified edition of Simpson's Euclid, can be a task requiring no great amount of skill or labour; and they may be led to ask why this work is better at the cost of ten shillings, than those of Rutherford or Maynard are at half the cost? Such at least, were our own thoughts till we had looked carefully into the edition of Mr. Potts. We shall, however, give our own idea of the advantages of this edition.

1. In all other editions (we take no account of the symbolical Euclids,) the arguments succeed one another without any specific division into parts; very similar, in its *effects* upon the mind, to that of a paragraph of English without the requisite punctuation. It is always a relief to the mind to be *mechanically* apprised of the conclusion of an argument; and even to have the separate members of an argument distinctly marked on the page. Mr. Potts has effected this completely by his arrangement; and his edition is thereby rendered much better adapted to the student's use than any previous English edition that we could point out. The time saved, and the facility furnished for study, are sufficient compensation for a trifling additional expense. We do not intend to say that this mode of writing out the details of a proposition is at all new; only that it is new in modern English editions of Eu[illegible]. We think, too, that the principle somewhat too far: for we would have the entire of each syllogis[illegible] paragraph, and the members separ[illegible] colons. This would concentrate the v[illegible] without confusing the sense. We would recommend this consideration to the author in the event of his printing another edition—an event of which there can be little doubt.

2. Each book is closed by a series of notes upon the general principles, and upon particular propositions in that book. At p. 47, is a brief description of the syllogism under the form in which it most commonly appears in geometrical reasonings; and in the same part of the work are descriptions of the axiom, postulate, theorem, problem, and other topics which belong to this stage of the subject. The notes generally betoken good sense and clear views; and are, for the most part, sufficient to meet all the difficulties that can present themselves to a candid and enquiring student, in the several books to which they are attached. The notes in the fifth book are peculiarly judicious and useful; which, from the greater difficulty experienced by students in general in conceiving clearly the objects and character of this book, renders them of especial value.

At the same time, as matters of criticism, and as matters of philosophy, we confess that we cannot agree with Mr. Potts upon some isolated points. As, however, these questions are not in general respecting topics which are likely to engage much of the attention of an ordinary student, we should not feel the present to be a proper time for their discussion, even had we space. There is sufficient matter of real value to the student in these notes to justify our recommendation of the book, whatever may be his and our special views, on particular, and somewhat delicate questions in the philosophy of geometry.

3. There is a succinct account of the history of geometry and geometers prefixed to the work. In this he has followed the earlier writers, here and there, perhaps, correcting the statements so taken, by a reference to Chasles's *Aperçu Historique des Méthodes en Géométrie.* The English geometers, however, who were not of either university, and who have been superior to those of all other nations in their cultivation of *pure* geometry, are omitted altogether—even any allusion to the existence of such. That Chasles should be ignorant of them is very pardonable; but that Mr. Potts should be, is, we think, incapable of any satisfactory apology. We would recommend him to acquaint himself with the numberless periodicals devoted to mathematical problems, that have been published for nearly a century and a half in England: and we will answer for his admission of the fact that the geometry of the Spitalfield's weavers, and the country school-masters, of the excisemen, and the mechanics and surveyors of that period, will not only put to the blush all that Cambridge has ever done, but all that has been cotemporarily done throughout Europe, in pure geometrical construction and analysis! We do not speak hastily or unadvisedly on this head; and are on all proper occasions, prepared to justify our statement. It is, unhappily, too much the practice with academic men to treat as unworthy, even of mention, any researches, however laborious and successful, that have not been made either by one of themselves, or been first printed in another language. There is no real dignity, however much assumption there may be, in such a course. We will hope for something like "justice for England" from Mr. Potts in a future edition of his work; for he is evidently not a bigoted person, and has probably been uninformed as to the existence of such works as those to which we allude.

That Cambridge men are not altogether ignorant of these works, may be instanced in numberless cases; but we shall content ourselves with reference to a single one—that of the Rev. Dr. Bland, in his "Geometrical Problems." That volume, badly conceived, and "muddled together" as it is, has had an extensive sale and very pernicious effect. It does not contain one single original proposition, nor a new demonstration of any kind; and more than this, the propositions themselves are mainly taken from the Ladies' and Gentlemen's Diaries, the Mathematical Companion, Leybourn's Repository, and other works of the same class, which we never saw (except by Mr. Hind) specifically referred to by a Cambridge writer! The "learned" doctor, too, in his hurry to heap together, in the most admirable confusion, the isolated pro-

positions that he found ready-made to his hand, could not exercise the discretion and judgment to select even the correct demonstration of a theorem where an incorrect one could be found; as, for instance, his prop. 43, section iii. In the work from which he took that theorem, were given two solutions, one by Mr. Whitley, which is valid; and the other by Mr. Butterworth, which (unlike most of that able geometer's productions) is inconsequential; and Dr. Bland has taken the latter—we suppose, because it appeared the shorter!

4. To return to Mr. Potts. Like Dr. Bland, and like many others, he has given a considerable number of "geometrical exercises;" but, unlike Dr. Bland, he has arranged them with due regard to their positions, in the order of a consecutive series of dependent truths; unlike Dr. Bland, he has left adequate work for the student's mental gymnastics, instead of furnishing a mere "cram-book;" and, unlike Dr. Bland, he has given, for the most part, his *immediate* authorities, the college and university papers from which they are taken. In the execution of this difficult and delicate task, Mr. Potts has manifested much judgment and geometrical taste; and, if we may judge from the solutions we have sketched of a few of them, taken at random, we should be led to consider them admirably adapted to improve the taste as well as the skill of the student. As a series of judicious exercises, indeed, we do not think there exists one at all comparable to it in our language—viewed either in reference to the student or teacher.

5. We cannot, however, accord to Mr. Potts a similar meed of praise for the *Introduction* which he has prefixed to these exercises, "On the Ancient Geometrical Analysis." It is somewhat confused, and extremely incomplete: it would neither give the student a distinct view of the character of the process, nor enable him to apply the geometrical analysis to the solution of propositions of any class. The few examples, too, which he has given, are neither instructive nor particularly elegant. He writes, indeed, on this subject, more like one to whom the subject is comparatively new, and who has merely "got it up," than as a master of the entire system, whose mind has been long disciplined by its study and practice. In fact, the race of English geometers is almost extinct, and the principles of analysis, though well understood and powerfully used, had never been developed by even them in a didactic and philosophic form. Each of the non-academic geometers of the past age seems to have acquired that immense power in the use of this instrument of investigation, which he so eminently possessed, from the study of good models of the method, rather than from any systematic treatise; and, indeed, with the exception of the Rev. John Lawson's, there does not appear to have been any serious attempt made to lay down the principles in a systematic form. Sir John Leslie, indeed, has given an admirable series of examples of the method, as applied to every class of geometrical propositions; but his work affords little in the way of *descriptive* illustrations of the process. Mr. Potts may, therefore, be pardoned in some degree for the meagre and unsatisfactory description of the geometrical analysis; but we trust, that before another edition of his work is called for, he will so far have studied this branch of his subject, as to be able to write with perspicuity and concentration on its several parts.

We have made these remarks in no unfriendly spirit towards Mr. Potts; and they relate to only a very few pages of his work—eight pages are too few, indeed, to be devoted to topics so important as a discussion and exemplification of the analytic method, determinate and indeterminate problems, loci, maxima and minima, and porisms. Of the rest of his work we entertain a very favourable opinion; and we are, indeed, gratified to see a single step made in the right direction, as regards the mathematical course of the University of Cambridge. That Cambridge should take the *initiative* in every modification in mathematical education, is a law of English society; for so strongly has that university

impressed the public mind with its own infallibility, that even its *Polloi* (we quote Dr. Whewell's term) take precedence of the ablest non-academic men, in all cases where an appointment to a school, or other professedly mathematical post, is concerned—whether the appointment rest in the Government, in trustees, or in the committee of a joint-stock school, Cambridge *will* give the law, and the schoolmaster *must* obey it. Is it not, therefore, a good omen for the future that Cambridge mathematics begins to take a form comprehensible by men of fair capacity and fair application? Is it not also a good omen that the impertinent pretensions of the "men of the gulph" to "high mathematical acquirements" shall be scouted by the university itself as unworthy of their countenance, when imposed upon the "gullable" community? Is it not, further, a good omen that men, in going to that university, will at length be able to acquire a fair knowledge of the *useful* branches of mathematical science, as well as be trained in the use of the highest and most godlike of their faculties—their reasoning faculties? But we desist; —the ground is too delicate, and we would not give pain to any one.

## EXHIBITION OF AMERICAN MANUFACTURES.

The last number of the *Franklin Journal* for December, 1845, contains a long account of an exhibition of American manufactures, held at Philadelphia, in October last, by the Franklin Institute, including the Chairman's Address, Report of the Award Committee, &c. We are not disposed to ascribe to such exhibitions much influence on the progress of the arts in any state of society; neither do we think it would be fair to any country to judge of its manufacturing skill from any number of specimens which may be thus spontaneously brought together; seeing that the ablest handicraftsmen—those whose works are in highest repute and greatest demand—are precisely those who are the least likely to be seen at such mob-competitions. Nevertheless, as there is always something to be learnt from even the worst of these (miscalled) national exhibitions — some hints and suggestions at least, if nothing of a broader and larger character—we shall proceed to jot down such things in the account before us, as seem to us most deserving of notice.

*Cotton Goods.*—The first premium in this department was awarded to a piece of cambric long-cloth, manufactured at James's steam-mill, Newburyport, Massachusetts. It is described as "a beautiful article, and the finest of the kind ever seen of American fabric"—"remarkable for the delicacy and softness of the finish, as well as for the fineness of the thread and its even texture;" though "more of that firmness and body, so requisite in long-cloths, would be desirable." Another first premium was awarded to some mousselaines de laine, printed by Dunnell and Co., for "the commendable skill shown in the execution; a fact of the more importance that a large amount of this description of goods is annually imported from abroad." A first premium was also awarded to some printed cottons from the American print-works, Fall River, Massachusetts, which are praised for "great beauty in the designs, richness and agreeable effect in the combinations, and a delicacy and exactness in the execution." The Award Committee express regret that the exhibition does not offer in this class a greater variety of articles for competition, which they very absurdly account for by supposing that "a disinclination exists among many manufacturers to make too public their improvements in design, or their novelties in inventions."

*Woollen Goods.*—The display in this department is commended for its "extent, variety of style, and general excellence." "American citizens need be no longer dependent upon foreign looms for suits of elegant and substantial clothing." Some black cloths, by Messrs. Farnum, of Waterford, Massachusetts, are considered to have been the best exhibited. "The superior quality of the wool, and the beautiful colour and finish, give evidence of great perfection, and reflect credit on the manufacturers and the country."

*Silk Goods.*—"Very good, and fully sustained the previously acquired reputation of our American silk manufacture." Some cravats, by Messrs. Hooley, of Philadelphia, are described as "very soft

and well woven: made of American silk, except the chain, which is spun from Chinese raw silk."

*Iron and Steel.*—We quote at length the principal passages of this branch of the report:—

"No. 1502, a bar of railroad iron, made by the Monteur Iron Company, at Danville, Pennsylvania, Henry Brevoort, superintendent, and deposited by J. L. Linton, secretary of the Lancaster and Harrisburgh Railroad Company. This is an H rail, 18 feet in length, and weighing 50lbs. per yard; of good form, well rolled, and handsomely finished. It is made from ore mined in the vicinity of Danville, and from the smelting of the ore to the finishing of the bar, *anthracite coal* has been the only fuel employed. This result is highly creditable to the manufacturers. Railroad iron made with *anthracite coal*, is a new article, of very great importance to the manufacturing prosperity of Pennsylvania; and as the production of good edge rails is one of the highest branches of the art of rolling iron, this specimen is considered worthy of the highest honour we can award, the first premium."

"Large sums have been invested, during the last three years, in extensive rolling mills, and with the protection now afforded to American rolled iron, the manufacturers in our country are rapidly becoming able to supply the demand for home consumption at reasonable prices."

"In the manufacture of bar-iron, both hammered and rolled, it is highly important that each manufacturer should endeavour to attain uniformity of quality in every article. It is too often the case that while some bars of a lot may be decidedly good, others will be much inferior, which is owing to a want of care in working. By obtaining a reputation for furnishing an article which may always be depended upon as equal to sample, and which will not disappoint the consumer, the manufacturer will consult his own best interests, and will be sure to be well rewarded for it in the end."

"No. 1593, a plate of boiler iron, rolled by Whitaker, Garrett, and Hewes, at Elk Works, Maryland, and deposited by M. D. Mahony, is of extraordinary size, being 53 by 94 inches, and $\frac{3}{8}$ thick, weighing 504 lbs. It is well rolled, and worthy of the third premium."

"No. 1544, two plates of boiler iron, rolled by Rowland and Hunt, deposited by Morris and Jones, are fine specimens of rolling. They are $\frac{3}{8}$ thick—one being 42 by 93 inches, weighing 379 lbs.. and the other 126 by 32 inches, 373 lbs. There is also a good sheet, by Forsyth and Son, 108 by 26 inches.

"We are pleased to observe an evident improvement in the manufacture of boiler iron, both with regard to the size of the plates, and the style in which they are rolled."

"No. 1504, a case of Wood's sheet iron, in imitation of the Russian, maintains the reputation of a valuable article which has come into extensive use."

"No. 1513, a roll of bright iron wire, in a single piece, upwards of four miles in length, drawn by John Holt, of South Easton, Pennsylvania, and made of iron from Buffalo, Rockbridge and Co., Virginia, is a beautiful specimen, and deserving of the first premium."

"No. 1579, specimens of blistered steel, by John Robbins, jun., of Kensington. One of these marked (B) from Swedish iron, is of very good quality, and superior to any presented at former exhibitions. It merits the third premium."

"Other specimens, from the same lot, with different marks, are favourably mentioned by the judges. One from American refined iron is noticed as not being equal in quality to the best specimens made from Swedish iron."

"Improvements in the manufacture of steel from American iron are still very desirable."

*Hardware and Cutlery.*—"Most of the articles exhibited" are represented as "comparing advantageously with the same description of goods of the best European make." Some "pocket and penknives," by Wild, of New York, are stated to be "all of good proportions and strength," and such, that "but for a slight defect in the grinding and polishing, they would bear the closest comparison with similar articles from English makers." Some clock and watch springs, by Prenot and Gertin, Philadelphia, appear to have been the first things of the sort ever exhibited; "though we learn," say the Committee, "that they have been for some years manufactured in the United States, and that they are preferred by watchmakers to the best imported." Of a great number of tools exhibited, the only ones thought worthy of more than a third premium were some augers, by Sanford, Newton, and Co., to which a first premium was awarded.

*Musical Instruments.* — The judges selected to examine and report in this class of articles, remark:—

"That they are fully aware of the difficulty in making improvements in pianos, and regret that among the great number exhibited (though equal to those in former

exhibitions and creditable to the manufacturers) none are found presenting any superior qualities to those of late years. Nicety of the mechanism in the keys, roundness, purity, and evenness of tone, are the great desiderata in this instrument. A majority of the judges disapprove of the Æolian attachment to piano-fortes, and likewise the attachment of harmonic pedals. They are strengthened in this opinion by the experience and practice of the great masters of Europe, who discountenance all these so-called improvements, as detracting from the legitimate character of the instrument, and rendering its use too complicated."

A first premium, in this class, was awarded to Mr. Martin, of Nazareth, for some guitars, of which it is said,

"The judges are of opinion that too much commendation cannot be bestowed upon these beautiful instruments. In strength and quality of tone they are unrivalled, and perfectly true throughout the whole scale. Being made with a degree of care hitherto unusual, they are found to bear the vicissitudes of our climate much better than the imported instruments. As this is now a permanently established branch of the arts, of a refined character in our States, the Committee desire to show their appreciation of merit, and aid in its encouragement, by the award of the first prize."

*Glass, China, &c.*—A glass vase, *five feet* high, by Messrs. Sweeny, of Wheeling, Virginia, is highly, and, we think, most deservedly commended:—

"Those only who are familiar with the manufacture of glass can appreciate the difficulties and hazards encountered in the execution of such a piece of work. The judges regard it as truly a triumph in American art, and from all the information they can obtain, it does not appear to have an equal for size and beauty in any country. It eminently merits the highest honour the Committee can bestow—the first premium."

Large lights of glass, of American manufacture, are stated to be "rare;" and of some that were exhibited the judges say, "the glass is not inferior in colour to the best foreign; but is not so free from specks and waves as is desirable."

*Bookbinders' Work.*—Some marbled paper, by Galbraith and Frost, of Philadelphia, is said by its "superior execution and finish to have established its reputation to the exclusion of that of foreign production. Being made at a price 40 or 50 per cent. cheaper than the imported, it has completely superseded all other."

*Hats and Caps.*—The improvement in the native manufacture of these articles is stated to be such that "competition from abroad is scarcely thought of. English hats, formerly plentiful, are now seldom seen, and the Paris silk hats are only worn because they come from Paris, and not from any superiority they possess."

*Clothing and Needlework.*—A specimen of thread lace, by Hannah Wheeler, of Salem, received a first premium as being "an exceedingly good article, and believed to be the finest ever made in America."

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The number of first premiums awarded was 51; of second, 52; and of third, 113. The exhibition was open for eleven days, and the number of visitors was estimated at 70,000.

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### PHOTOGRAPHIC EXPERIMENTS.

Mr. Claudet described, at the meeting of the Society of Arts, on the 28th ult., some interesting experiments which he had recently made in relation to the photographic art, in which he is so distinguished a proficient.

The first series of experiments regarded the photographic qualities of light of different colours. Blue proved to be the most powerful photographic agent; and yellow the weakest. One of the most beautiful experiments, by which this was proved, consisted in throwing the prismatic spectrum on paper and on the silver plate, the colours being marked on the paper, and the effect remaining on the photographic plate. He thus showed that the photographic prism presents effects very different from the apparent intensity of the prismatic spectra.

[This difference in the photographic effect of different colours has been made the groundwork of a most ingenious invention for preventing the forgery of bank-notes, lately patented by Mr. Grubb, of the Bank of Ireland, of which we shall shortly be able to give our readers a full account.]

Another set of experiments had reference to the photographic action of the moon. Mr. Claudet stated that he had obtained a powerful picture by five minutes' exposure. He hoped to be able to obtain an accurate Daguerreotype of the moon's surface drawn by herself on a silver plate!

In this last speculation Mr. Claudet is not so original as he probably imagines;

neither is he likely, we suspect, to care much about vindicating his right of property in it, when he learns with how much ridicule a kindred speculation has already covered one very worthy and ingenious gentleman. We allude to the photographical method of delineating nebulæ, gravely reported by Mr. Taylor, of Liverpool, to have been discovered by Rondoni, of Naples, and for which he is thus cleverly handled in one of the Sheepshanks' Letters lately reviewed in our pages.

"Unhappily for Mr. Taylor, he undertook to announce, along with these minor flourishes, 'a discovery of the highest importance to astronomical research' in the following terms:—

"*Photographical Delineation of Nebulæ.*

"* * * 'Fortunately the Roman astronomers have hit on a means effectually to prevent future mistakes of vision or delineation. They have brought the Daguerreotype to bear on the object, and throwing the photographic image of the nebula and its stars on a lithographic stone, have, by an ingenious invention of the Signor Rondoni, which is still kept secret, fixed it there. From that stone they have been able to take impressions on paper, unlimited in number, of singular beauty, and of perfect precision; each star, each filmy nebulous streak, faithfully depicting its own position. * * * Altogether it is a discovery of the highest importance to astronomical research.'

"Shall I be believed when I say that this pompous announcement is all moonshine, that the discovery concerns lithography much, but astronomy little; that Mr. Taylor, having probably little acquaintance with Italian, and being certainly ignorant of the principles of mechanics, optics, and the Daguerreotype, has totally misunderstood the original? De Vico states very simply and clearly (see Memoir, p. 27) that the lithographer Rondoni has discovered a way of throwing a drawing on stone by the Daguerreotype (*i. e.* substituting a prepared stone for Daguerre's silver plate and Talbot's sensitive paper) such, that impressions can be taken from the stone by the ordinary lithographic process. Two specimens are given of the results of this process (which possibly may be of use in the arts), on the first of which Signor Rondoni has written

"*Fr. Rondoni dis. dal vero e trasportò il disegno in pietra col Dagerrotipo.*

"This I translate, 'F. Rondoni drew from nature, and transferred the drawing to stone with the Daguerreotype.' *Dal vero* 'from the true,' is the phrase used by artists to show that the design is not a copy, but from the thing itself."

## NOTES AND NOTICES.

*Patent Rotary Fire Engine.*—The *Midland Counties Herald* gives an account of a trial lately made at Birmingham of a new fire-engine invented by a Mr. Farmer. Three engines of different sizes, manufactured for exportation, were tried. The largest threw a perfectly compact stream of water, half an inch in diameter, to a height of upwards of sixty feet; and, by substituting a rose for the jet, covered an area of nearly forty feet diameter. Another of the engines was constructed so as, if required, to act as a pump, for the purpose of supplying water to the larger engine, or for any other purpose. The principle in all these cases is that of the action of a wheel within a circular chamber, with which the pipe leading to the cistern and one end of the hose communicate. Attached to the wheel are slots which close the apertures of each of those pipes at the same time. Let the wheel be turned as it may, one-half of the chamber is *in vacuo*, and thus the loss of the up-stroke in the ordinary construction of the pump is avoided, and the machine, by one revolution, throws out the water through the jet, and draws it up from the cistern. The application of the multiplying power of cog-wheels produces five revolutions of the central wheel for one turn of the winch, thus of course rendering the working of it so much easier. The trial gave great satisfaction, it being evident that the rotary engine was much more effective and certain in its operation than the ordinary fire-engine.

*Importation of Foreign Patterns.*—Government, considering the very active competition in the manufacture of articles of every description in all parts of the world, and that every possible facility and encouragement should be afforded to British manufacturers, have deemed it advisable, that foreign samples and patterns *bonâ fide* intended for the purpose of improving the manufactures of the country, shall be exempted from the payment of any duties. It has been considered necessary, at the same time, to impose certain restrictions for the security of the revenue; and to prevent an abuse of the indulgence the following regulations have been adopted:—1. That the indulgence is to be extended solely to parties who are *bonâ fide* the manufacturers of the particular articles of which they may require patterns to be delivered duty free. 2. That as regards manufactures of silk, woollen, and other fabrics; and also parts of articles, the quantity, in each case, be not more than is absolutely necessary or requisite for the purpose intended; and as regards models or patterns, consisting of complete articles, only one of each to be allowed. 3. That in each case, the manufacturer be required to make a declaration, that the goods prepared to be delivered duty free as patterns, &c., are intended to be used by him for such purpose, and will not be disposed of either for sale or private use. 4. That the indulgence in the first instance be confined to the ports of London, Liverpool, Bristol, Hull, Leith, Glasgow, Dublin, Cork, and Belfast, subject, however, to such additional regulations as may from time to time be deemed requisite. It will be seen that this privilege extends to the whole range of manufactures of which patterns are required to be imported, for manufacturing and improving purposes, subject only to a few regulations, necessary and expedient to be directed and observed, and must be considered a very advantageous concession to the manufacturing trades of this country.

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## CRAWFORD'S PATENT DIBBLING MACHINE.

Fig. 1.

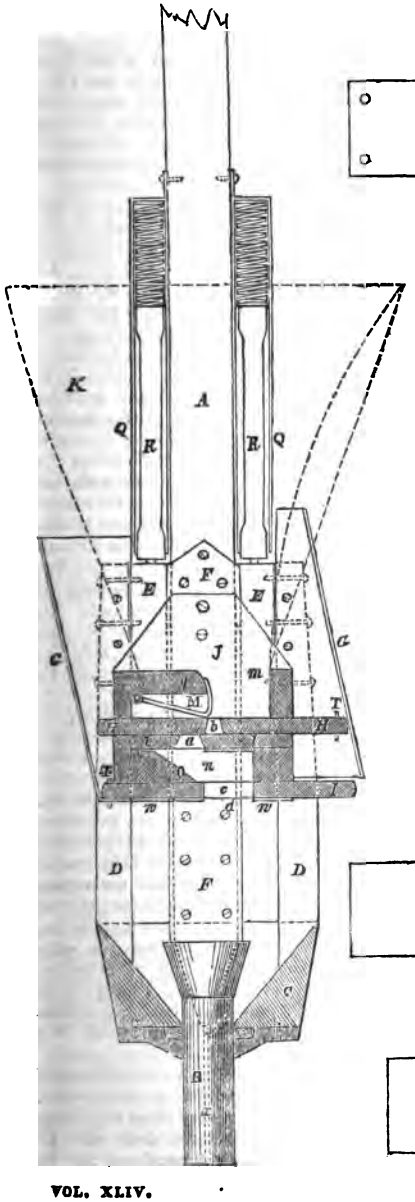



Fig. 5.

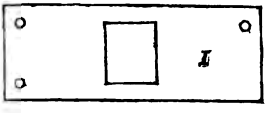



Fig. 6.

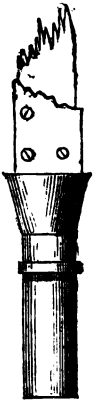


Fig. 4.

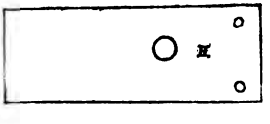



Fig. 3.

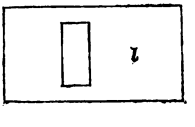
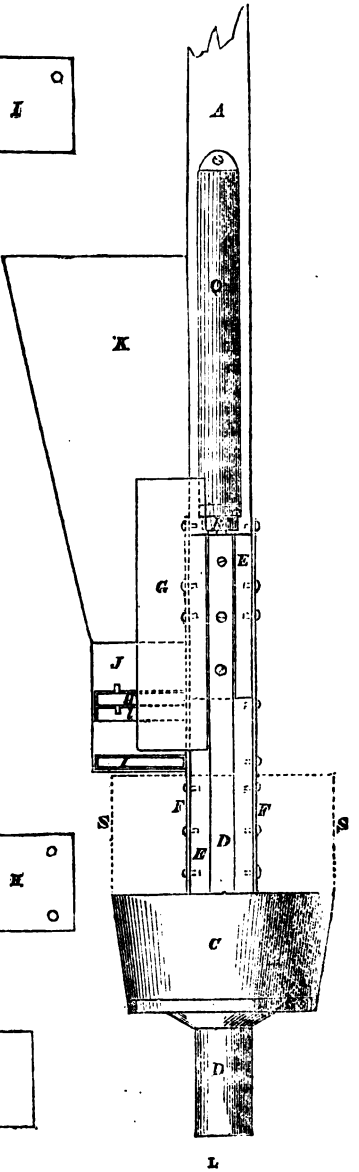



Fig. 2.



## CRAWFORD'S PATENT DIBBLING MACHINE.

[Patent dated August 7, 1845; Specification enrolled February 7, 1846.]

THE dibbling machine, which forms the subject of this patent, presents this remarkable peculiarity, that it may be either worked as a hand-tool or as a power machine; that is to say, it may either be worked as a single instrument by hand, like a spade or hoe; or two, three, or more instruments of the sort may be mounted in a carriage frame and worked simultaneously through the medium of wheel work. A description of the single-hand instrument will here be sufficient, as the modifications necessary to adapt it for more extended use are but few and inconsiderable. It is a most ingeniously-constructed tool, and, we have little doubt, will be found to answer most effectually in practice.

Figure 1 is a front elevation of it partly in section; and fig. 2, a side elevation. A, is a wooden staff which terminates at bottom in a solid metal point, B, which may, for loose and friable soils, be made of a blunt cylindrical form as represented in the engraving; or where the soil is stiff and tenacious, be made more or less tapering and pointed; C is a cup with a hole in the bottom, through which the point B is moved up and down as afterwards explained; and D D, two upright arms, by which this cup, C, is attached to two slides, E E, which move up and down in grooved bearings against the two sides of the staff; F F, are two plates, which are attached to the staff at front and back, and are made a little broader than the staff, in order that they may prevent the slides, E E, from diverging to either side; J is a seed-box fixed to the front of the staff, which is divided into an upper and under compartment, *m* and *n*, by a false or shifting bottom, *l l*. In this false bottom there is a seed hole, *a*, and in the fixed bottom, *w*, of the box, a similar seed hole, *d*, and each of these holes is opened or closed by means of two slides, H and I, which move to and fro on the top of *l* and *m*, respectively, (each slide projecting considerably through both sides of the box, J,) and have holes, *b* and *c*, in them to coincide with the holes, *a* and *d*. Plans of *l*, H, and I, are given separately in figures 3, 4 and 5. On one side of the upper division, *m*, of the seed-box, J, there is a broad metal spring, M, the fast end of which is attached to the side of the box, and the other, or free end, is curved backwards against a projecting shoulder of wood, *g*, against the under surface of which spring the slide H passes when it is pushed inwards. O, is an angularly inclined side piece in the under compartment, *n*, which serves to deflect the seed from under the aperture *a*, towards the discharge orifice, *d*. G G are two angle pieces attached to the arms, D D, which, as these arms are moved up and down, press against the edges of the slides, H and I, and cause them to move from side to side; Q Q are two tubes, attached to the sides of the staff immediately above the slides, E E, and enclose rods, R R, which are connected to spiral springs, P P, in the tops of the tubes, and exert an elastic pressure on the slides, E E, and through them on the seed-depositing cup, C; T T, are pegs, or stops, which serve to keep the slides, H and I, in their places; K is a hopper, from which the seed-box, J, is supplied. The dotted lines, *x x*, denote two air passages made through the dibble point, in order to facilitate its working.

The action of the machine is as follows:—Let it be supposed, that at commencing, the under compartment, *n*, of the seed-box contains a charge of seed ready for delivery into the cup C, and that the upper apertures, *a* and *b*, are for the moment closed: on then forcing the machine downwards into the ground, the angle pieces, G G, coming into contact with the slide, I, move it sideways till its seed-hole, *c*, coincides with the seed-hole, *d*, in the bottom of the box, and the seed falls through them into the cup C, around the dibbling point, B. The shaft being then pulled upwards, the seed drops from the cup, C, into the hole just made by the dibbling point, B, while the angle pieces, G G, acting reversely against the slides, H and I, the bottom orifices, *c* and *d*, are closed, and the upper orifices, *a* and *b*, brought to coincide, whereby a fresh supply of seed is delivered into the under chamber, *n*, to be afterwards discharged into the ground by a repetition of the preceding process. Should any of the seed not clear the holes, *a* and *b*, as the slide H is pushed inwards against the under face of the spring, M, that spring yielding readily to the pressure of the intercepted seed, allows it to return back into the upper compartment, *m*, without any cutting or bruising of it taking place. The parts *l*, H, and I may be at any time changed for others having apertures larger or smaller, so as to suit seed of a greater or smaller size, and it is proposed to furnish with each machine an assortment of these parts adapted to different sizes of seed. When the seed is of a very large sort, such as beans, or peas, one thick slide, with an orifice of corresponding dimensions, may be used instead of the two pieces, H and *l*. The

cup, C, may (if preferred) be prolonged upwards as far as the seed-box, J, as indicated by the dotted lines, S S. The dibble point may be made hollow if preferred, and when hollow, it may consist either of one piece attached to the shaft, or of two pieces or halves, running in the direction of the length of the shaft; one attached to the shaft, and the other to one side of the depositing cup, C, (as if it were a prolongation of that side of the cup.) It may also have a packing of sulphurized caoutchouc, or some other elastic substance, inserted horizontally in it, as shown in figure 6; or the hole in the bottom of the cup, C, may have a lining, or packing of the like elastic substance, for the dibble point to work through, as indicated by the dotted lines in fig. 1. And further, the machine may be made to deposit seed and manure alternately, by employing two sets of the parts G, H, I, J, L, M, and O O, one set being employed to transmit the manure, and the other the seed.

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MISCELLANEA MATHEMATICA—NO. 5.

*Centrolineation.*

All our readers who are conversant with practical drawing, whether of perspective, ordinary orthographic projection, or descriptive geometry, must have encountered the following problem:—

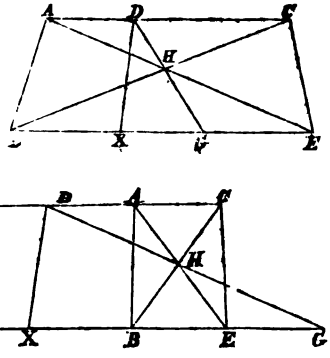
"*Given two lines which are inclined to each other, but whose intersection would fall beyond the limits of the drawing; it is required to draw through a given point another line which shall tend towards the inaccessible intersection of those lines.*"

Many methods have been proposed for solving this problem; yet in few of them have been kept in view the requisite qualities of a *practical* solution. The geometrical difficulty is inconsiderable; the convenient arrangement of the work is the main object at which we should aim. The following are selected from a great number of solutions which are scattered through different works; and they are, we believe, the most facile and elegant that have been offered to the notice of draughtsmen.

*First Solution.*

(... *nier*, Théorie et pratique de la coupe des pier... et des bois, tom. i. p. 335. 2ieme edition.)

... A B, C E be the inclined lines, and ... the point through which a line is to be drawn, such that if all the three lines were sufficiently produced, they would pass through the same point.




Through D draw any convenient line, A D C meeting the given lines in A and C; and at any convenient distance the parallel B E. Join A E, B C intersecting in H; and the line D H meeting B E in G. Finally, make B X equal to G E, and D X will be the line required.

For, the triangles A D H, E B H are similar; as are also A C H, E G H: and these give, respectively,

$$A D : E G :: A H : E H,$$
$$A H : E H :: A C : B E;$$

whence,

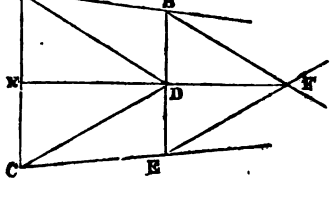
$$A D : E G (= B X) :: A C : B E.$$

The parallels A C, B E being therefore divided proportionally in D and X, the three lines A B, C E, D X tend to the same point.

*Second Solution.*

(*Davies*, Monthly Magazine, Aug. 1825.)

Let A B, C E, be the given lines, and D the given point; draw the parallels A C, B E, as in the preceding solution: parallel to A D draw B F, and parallel to C D draw E F; then F D being drawn, it will be the line required.




For the three pairs of triangles A D X, and B F D, C D X and E F D, and A D C and B F E, are each pair similar; and hence,

$$A D : B F :: A X : B D,$$
$$C D : E F :: C X : E D,$$
$$A D : B F :: C D : E F;$$

wherefore,

$$A X : X C :: B D : D E,$$

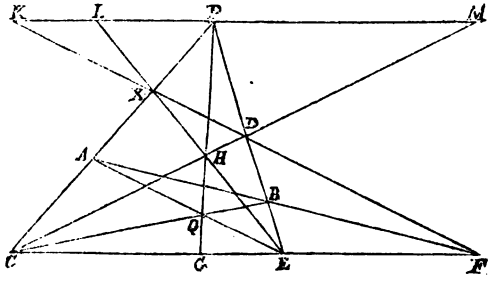
and the conclusion follows as before.

### *Third Method.*

(*Servois*, Solutions peu connues de différens problèmes de Geométrie practique. Metz., an. xii. p. 41.)

Let A B, C E and the point D be given as in the preceding constructions: draw any lines P B D, P A C, the former passing through D; and join A E, B C intersecting in Q, and draw P Q; draw C D meeting P Q in H, and E H meeting A C in X. Then D X is the line required.

For let F be the point in which A B, C E if produced would actually meet; through P draw K M parallel to C E, meeting A B, A E, B C in K, L, M, respectively; and let P Q meet C E in G. Then by the similar triangles which are thus formed, we have




$$P X : X C :: P L : C E,$$
$$E D : D P :: C E : P M,$$
$$C G : G E :: P M : P L,$$
$$P K : C F :: P X : X C,$$
$$E F : P M :: E D : D P,$$
$$E G : G C :: K P : P M,$$

and by compounding these ratios, we obtain at once

$$C G : G E :: C F : F E.$$

Whence it follows that (C E being chosen points) the points F and G are mutually dependent upon each other, and that they are altogether independent of the position of the point P.

From this we see that wherever in the line P G the points H and Q are taken, the corresponding lines X D, A B will cut C E in the same point F. Wherefore, the line X D tends to the intersection of A B, C E.

### *Scholium.*

The first solution requires the use of the parallel ruler and compasses; the second, of the parallel ruler only; and the third requires only the common ruler. They are not, however, all equally eligible in practice. The setting off the point X in the first is an unnecessary operation, and all marks so made are injurious to the paper. In the second, the only parts that are necessary to be actually traced are the parts of B F, E F, in the conjectural region of F. In the third, the number of lines which it is necessary to trace will be injurious to the drawing; as, however lightly made, the abrasion of the surface by "rubbing out" must render it less fitted for the reception of the final shading. It is also attended with more labour, in order to dispense with the parallel ruler—whilst in no circumstances under which a drawing is made, can this be an actual condition. It is, however, much used by the French draughtsmen; and is, at all events, a beautiful application of their *theory of transversals*.

When there is a considerable number of lines to be drawn through points which *are not situated in one straight line*, all these methods become very complex in their operation; still such a state of the data, scarcely ever, if at all, occurs in practical cases. Should such, however, in any case occur, no doubt the use of Nicholson's *Centrolinead* is most advisable.

On this account we shall annex the construction and use of that instrument, as a

### *Fourth Solution.*

(*Nicholson*, Practical Perspective, p. 86.)

The following is the author's description of the instrument:—

"The centrolinead is an instrument which consists of two legs, jointed together like a carpenter's rule, with a blade for drawing, so that the drawing edge of the blade may be fixed at any angles with each of the two legs, and pass through the centre of the joint. The instrument is represented at fig. 1, as if in the act of drawing converging lines. The running edge of one of the legs of the instrument and the drawing edge of

Fig. 1.

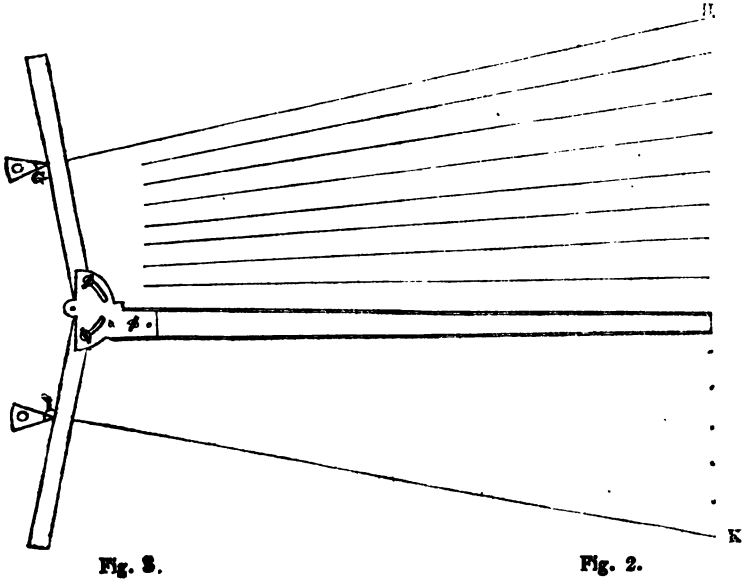



Fig. 3.

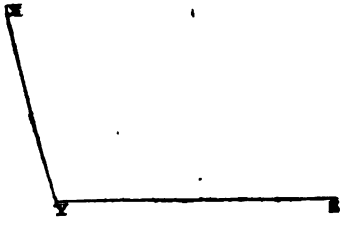
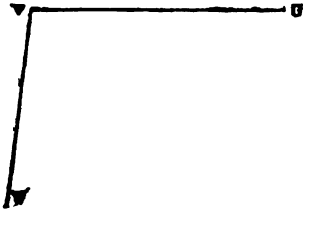


Fig. 2.



the blade, is first set to a given angle U, V, W. fig. 2; and that angle is made stationary by a screw, which passes through a circular apperture, made in a brass plate fixed to the blade into the leg so set. The moving edge of the other leg, and the drawing edge of the blade are then set to any other angle, as fig. 3, exactly in the same manner.

"This machine is made by Mr. Dollond, St. Paul's Churchyard, London; who has long been celebrated for his accuracy in the manufacture of optical and mathematical instruments.

"N. B. The two edges of the legs which pass through the centre or axis line of the joint, are called the running edges; and, observe, that the instrument is so constructed, that the running edge and the drawing edge of the blade, pass all three through the axis of the rule-joint."

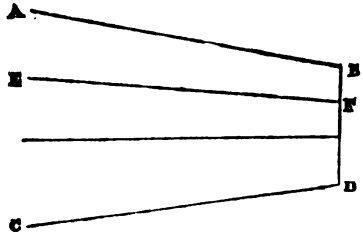
The use of the instrument is thus described by its inventor:—

"Two converging lines A B and C D, 4 and 5, being given to draw another line through a given intermediate point E, that shall tend to the same point by the Centrolinead, B.

"Put a pin in each of the two given lines in any convenient points B and D; lay the centre of the rule-joint upon one of the pins, B, and the drawing edge of the blade upon B A; move one of the legs round

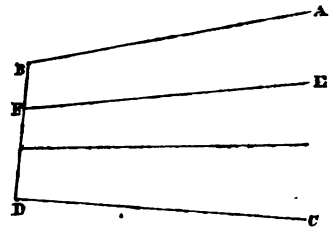
till its sliding edge fall upon the pin D, and fasten the angle formed by the two edges thus set, by means of the screw. Move the whole instrument, so that its centre

Fig. 5.



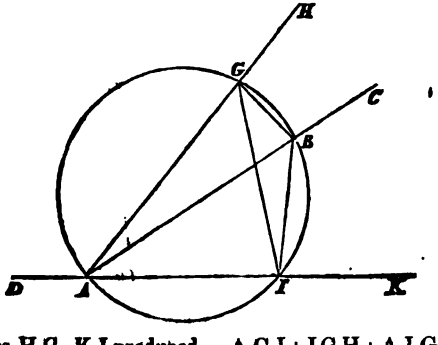

may be placed upon the point D, the drawing edge of the blade upon the other line, C D; then move the sliding edge of the other leg round, till it coincide with the line,

Fig. 4.




D B; then fasten this angle also by means of the screw which belongs to it; then, if each of the running edges is placed upon each pin, with the under side of each leg, and the under side of the blade upon the paper, every line that can be drawn between the two given lines along the drawing edge of the blade while the centrolinead is stationary, will meet the two given lines in the same point which they themselves meet."

We are not at this moment certain whether any effective demonstration of this instrument, and the processes dependent on its construction, have been given by the author; but, most probably, such a one was given to the *Society of Arts*, who rewarded Mr. Nicholson with their silver medal for the invention, in 1815. As, however, the principle is easily explained, we shall give the demonstration, without taking the trouble of making the reference. His original reasoning could not, we think, differ very much from our own.




Conceive the lines H G, K I produced to meet in A, and let K A be produced to D; let B be any position of the joint, and B C the corresponding position of the drawing edge of the blade of the instrument. Let also $\pi$ denote two right angles. Then, by a familiar property of the motion of the legs G B, B I, upon the pins G and I, the point B describes a segment of a circle. We shall, first, prove that this circle passes through the point A. For we have

$$A G I + I G H = \pi,$$

and $$A I G + G I K = \pi;$$

whence,

$$A G I + I G H + A I G + G I K = 2\pi \ldots\ldots (1)$$

Also by hypothesis,

$$C B C + B C I + I B G = 2\pi, \text{ or}$$

$$H G I + G I K + I B G = 2\pi \ldots\ldots (2)$$

Wherefore from (1, 2,) we have

$$I B G = A G I + A I G = D A G$$

Whence the exterior angle D A G; quadrilateral A G B I being equal interior opposite one G B I, the a points, A, G, B, I, are in a circle. is, the circle whose segment is passes through the point A.

Join A B; we have to show that A BC, are in one line. For, by the circle, we have A B C = A I G; and by the hy-

pothesis, G B C = G I K; whence also,

A B G + G B C = A I G + G I K.

This latter pair, A I G + G I K is equal to two right angles, since A I K is a straight line; and hence also, the pair A B G + G B C, is equal two right angles, and A B, B C are in one straight line.

The architect and engineer owe much to the memory of Nicholson. His writings are, indeed, the only ones to which the profession can refer with any chance of finding what they want. Still he is generally wanting in clearness of style and elegance of demonstration, and above all, in that generality of view which is so essential to the wants of our own time. The instrument here spoken of is, however, *perfect* of its kind, whether considered in reference to its theory or its use. It is, in fact, a beautiful adaptation of an elementary property of angles, not exceeded by any; and is, perhaps, only rivalled by the application of an equally simple property by Hadley, in the construction of his sextant.

## MR. STEPHENSON'S LONG-BOILER ENGINES.

Sir,—Your 1174th Number (Feb. 7, 1846,) contains Mr. Robert Stephenson's reply to General Pasley, (addressed to the Directors of the Norfolk Railway:) I solicit your permission to make a few remarks on that part of Mr. Stephenson's letter which refers to the long boilers of his engines. I had always considered that the object to be gained by increasing the length of the tubes was the introduction of a greater amount of evaporating surface, and thereby increasing the power of the engine, and not that of "saving fuel by preventing the escape of a large quantity of waste heat up the chimney." Indeed I must confess my surprise that a gentleman of such unquestionable ability should advance such a position. Mr. Stephenson makes his tubes about 4 feet longer than usual, that is, 12 feet instead of 8 feet. Now, Sir, I feel no hesitation in asserting, that if Mr. Stephenson had made his tubes 4 feet shorter and increased the number of tubes, so as to have made the proportions between the evaporating surface and fire-box surface the same as it now is in his engines, he would have obtained just as good a result, so far as economy in fuel is concerned. To render myself clearly understood, I state that if in Mr. Stephenson's boiler, with 12 feet tubes, the heat escapes into the chimney at the temperature of 600 degrees, a boiler with tubes 4 feet long, having the same area of grate bar and the same area of tube surface, the blast pipe being so regulated as to produce such a draught as would cause the heat to escape into the chimney at 600 degrees, precisely the same results as to economy will be produced by both boilers. If I am wrong, I shall be pleased by any of your correspondents setting me right; but the thing appears self-evident to me, that, provided you maintain the same proportions between grate-bar, evaporating surface, and temperature, the results must be identical—that in short it matters not one tittle, whether you have a very long narrow surface for the heat to act on, or a very short wide surface. Indeed the results of my practice induce me to give a preference to the latter.

I am, Sir, your obedient servant,

L. P.

London, February 10, 1846.

## PROFESSOR FARADAY'S RECENT DISCOVERIES IN MAGNETISM.

Sir,—Not having sufficient leisure to attempt making experiments in magnetism and electricity, I hope it will not be thought too presumptuous to suggest an idea to others, who have time and the necessary apparatus more at their command for researches of this interesting, but difficult character. In the course of the recent discovery of the celebrated Professor Faraday, he has ascertained, that when a bar of glass or bismuth is suspended freely from its centre between the poles of a powerful magnet, it takes a direction at right angles to the line joining the poles, or at right angles to the position which a magnetized needle, or bar of iron suspended in the same position, would take. He also states, that the movement is caused in the former case by repulsion, in the same way as attraction is the influencing agent in the other. Now there was a most important experiment proposed long back by the celebrated Arago, which has not, in my opinion, met with the attention it deserves, namely, that the repulsion, in somewhat similar circumstances, is but of a *momentary* nature. The experiment, therefore, that I would take the liberty to suggest, would be one to ascertain, whether in the case

of the recent discovery, the repulsion is not also of a temporary nature. The experiment of Arago was this: he suspended a horse-shoe magnet from one end of a balance, and put in weights to balance it; he then put a plate of copper in motion horizontally, immediately under the magnet, when the latter ascended; and when the motion ceased, the repulsion between it and the copper also ceased, and the magnet descended to its first position. It therefore appears to me a circumstance well worthy of inquiry, whether the repulsive property of the magnet, with respect to these non-ferruginous substances, is of the same description in both of these experiments; for if not, it opens a wide field for speculation. The wonderful effects of magneto-electricity arise from the momentary action of the magnet, but it would seem from the above experiment, that it has also a permanent action in the presence of other bodies.

I am, Sir,

A CONSTANT READER.

P.S. I should have mentioned, that a glass screen was placed between the magnet and the plate of copper in M. Arago's experiment. If it should turn out that a permanent action of a repelling nature exists, in the experiments of Professor Faraday between the magnet and bar of glass, or non-ferruginous substance, then must it follow, as a matter of course, as proved by M. Arago's experiment, that rapid motion increases to a considerable degree such repulsion, none being perceived before the motion. Now, in the case of Arago's experiment, this might be caused by making use of a horse-shoe magnet, and having two opposite poles near the copperplate. But this only makes the experiment of the more importance, and suggests that it should be repeated with only a single pole. A powerful magnet might be made to rotate with a single pole upwards and a plate of copper suspended from the balance.

## WHEELER'S EXPANDING SPRING PISTON.

(Registered under the Act for the Protection of Articles of Utility.)

Sir,—Some time prior, as well as subsequent to the perfecting his expanding metallic piston by the late John Barton, he made numerous attempts to adapt a similar principle to ordinary pumps, the pistons of which, working in cold, and frequently foul water, without an opportunity for the requisite lubrication, rendered the employment of metallic packings inapplicable. Some of Mr. Barton's contrivances for this purpose were ingenious, but none of them were successful in practice.

Mr. C. Wheeler, of Speenhamland, has, however, been more successful in this matter, having introduced a spring piston adapted to all kinds of pump-work, possessing great practical advantages.

A large number of pumps fitted with the spring pistons, have been in varied and extensive use for nearly twelve months, and have given great satisfaction to the parties who use them.

The nature of Mr. Wheeler's improvement will be readily understood by reference to the accompanying engravings, where fig. 1 represents a disk of metal,

Fig. 1.

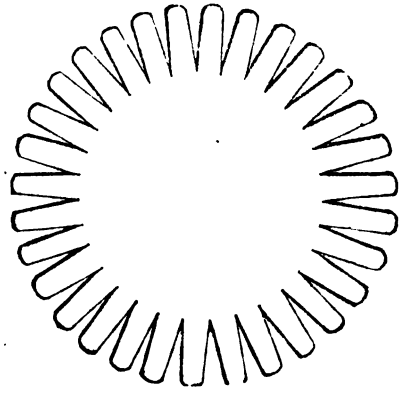
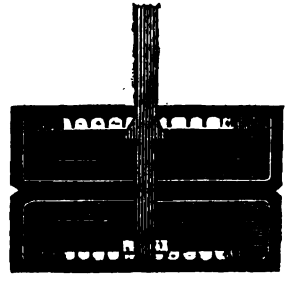


Fig. 2.

Fig. 3.



(brass being generally preferred, as being sufficiently elastic without liability to rust) notched all round so as to admit of being bent up into the crown form, as shown in fig. 2. Fig. 3 is a sectional view of a piston for a force pump, with their appendages complete; *a a*, are the two piston plates, between which, and the ordinary cupped leathers, the springs, fig. 2, are inserted. The outward pressure of these springs operates to keep the edges of the leathern cups in close contact with the working barrel at all times, effectually counteracting the natural tendency of the leather to shrink, and withdraw when dry. This construction of piston also insures a constantly water-tight joint without the necessity for tight packing, always objectionable from the loss of power it entails, as well as its injurious action on the pump barrel, especially in situations where particles of sand or gravel are liable to be raised with the water. The plunger pumps fitted in this manner are proof against injury from such matters, and form the nearest practical approach to a perfect *frictionless pump*.

The great value of this important improvement in pumps, stuffing-boxes, &c., is somewhat confirmed, from the circumstance of its having been re-invented and patented by Mr. Ward, of Leeds, the abstract of whose specification appears in your 1174th Number (page 11.) Mr. Wheeler registered his invention in *February*, 1845, while Mr. Ward's patent was sealed in the *June* following; his claim to this invention is therefore void, and he will do well to avail himself of the power given him to enter a *disclaimer* of this part of his invention, so as not to invalidate such of his plans as are really new and useful, by retaining that which is not so. Yours, respectfully,

W. B.

## THE VULCANIZED CAOUTCHOUC AND GUTTA PERCHA.

Sir,—Whenever I am at a loss, I have only to apply to you for information, and you, or some one or other of your numerous correspondents, is sure to reply to the call.

Two new articles have lately been announced, viz., Vulcanized caoutchouc, and gutta percha. The first is said to retain its elasticity in temperatures at which the ordinary caoutchouc becomes quite hard. This defect renders the ordinary India rubber cushions of a billiard-table very uncertain in frosty weather, unless a moderate heat be kept up in the billiard-room night and day.

By what process is the Vulcanized India-rubber rendered capable of retaining its elasticity in frosty weather, and may it be depended on?

As to the gutta percha, what experiments have as yet been made with it, as to combining with other gums, wax, &c.? Apparently it would be a useful ingredient for tempering the brittleness of shellac, far superior to caoutchouc. In regard to the patent marine glue, I called your attention to it in one of your volumes some years ago, under the signature of "A Joiner," expressing my doubt of its possessing any adhesive powers beyond that of the shellac itself, or any degree of elasticity, after being melted and employed as a cement, though it might certainly render the shellac a little more tough. One or two excellent letters on the subject appeared in your journal in reply—one of them, if I remember aright, from your ingenious and talented correspondent, Colonel Maceroni, whose attention I should wish to call to the very curious gum in question (gutta percha), which for its use in the arts, will, I imagine, far excel caoutchouc. Next to the malleability of glass (still a desideratum, I opine,) one of the most valuable discoveries would be the plasticity of wood; capable of being moulded into any shape by heat—and this desideratum the gutta percha seems to supply. Your obedient servant,

A JOINER.

Edinburgh, 14th Feb., 1846.

*Note by the Editor.*

The Vulcanized caoutchouc was invented and patented by Mr. Thomas Hancock about two years ago, and a very full abstract of his specification was given in our Journal, No. 1126, for March, 1845 The process consists in first mixing up with the caoutchouc, while in a plastic or liquid state, a portion of sulphur, and afterwards subjecting the compound substance so formed to a secondary action of sulphur, either by immersing it in a hot bath of liquid sulphur for an hour or two, or exposing it for the same time to the fumes of burning sulphur. When thus prepared, caoutchouc has no longer the stickiness peculiar to it in its origina'

state, and remains unchanged under all ordinary degrees of temperature.

The "gutta percha," or as it is sometimes called "gutta tuban," deserves all that our correspondent states in its praise, and, indeed, much more. It seems likely, at no distant day, to supersede the use of caoutchouc in many articles of manufacture, and to be applied to many more for which caoutchouc is wholly unsuitable. Like caoutchouc it is of a strongly adhesive or agglutinating quality, and perfectly repellant of water; but it is advantageously distinguished from it in being entirely free from stickiness when dry,—in being nearly inodorous—in resisting the action of grease and oils—in mixing readily with paints, pigments, and other colouring matters—and above all, in becoming by *mere immersion in warm water*, so soft and ductile that it may without farther treatment be kneaded, or moulded, or rolled out, or pressed into any desired shape, or even spun out into thread! It may be sulphurized too, like caoutchouc, and rendered thereby equally proof against all variations of temperature. Several patents have been already taken out for applications of this article to manufacturing purposes. Of these we shall give a complete list, with abstracts, in an early Number.

## REPORT OF THE GAUGE COMMISSIONERS.

The Commissioners (Sir Frederick H. Smith, Professor Airy, and Mr. Barlow,) appointed by Royal Warrant of the 11th of July last, "to enquire whether in future private bills of Parliament provision ought to be made for securing an uniform gauge, &c.," have this week made their Report. It is distinguished by great ability, impartiality, and clearness, and may be considered, on the whole, as entirely satisfactory.

The enquiries of the Commission were directed to three points—*first*, whether an uniform gauge should be compulsory on all future railways; *secondly*, whether it is possible to obviate or mitigate the evil arising from want of uniformity; *thirdly*, whether it is expedient or practicable to effect an uniformity on railways already constructed, or in process of construction. In considering these questions, it became necessary to decide a *fourth*, as arising immediately out of the *third*, viz., whether the broad or narrow gauge be preferable for general purposes.

I. On the first point, involving the mere abstract advantage of uniformity, one decision only could have been anticipated. The committee have considered it under the following heads:—(1) as applying to fast trains—(2) to ordinary trains—(3) to goods trains—and (4) to conveyance of troops. With regard to the 1st head, they do not think the inconvenience of a break of gauge of sufficient importance to call for legislative interference. With regard to the 2nd and 3rd, they pronounce the break an intolerable evil, imperatively demanding remedial measures; and, with regard to the 4th, they are of opinion that it might expose the country to serious danger.

II. After considering in detail the various plans suggested of mingling the broad and narrow gauges by double lines of rails, or of adapting the carriages to fit either gauge by shifting wheels or placing them on trucks, the Commissioners pronounce them severally to be impossible or dangerous, and arrive at the conclusion that none of them are calculated to remedy in any important degree, the inconveniences attending a break of gauge.

III. The question of the comparative merits of the broad and narrow gauges is examined under four divisions—(1) safety, (2) accommodation and convenience for passengers and goods, (3) speed, (4) economy. We give the general conclusions at which the Commissioners have arrived, in their own words:—

"1. As regards the safety, accommodation, and convenience of the passengers, no decided preference is due to either gauge, but on the broad gauge the motion is generally more easy at high velocities.

"2. In respect of speed, we consider the advantages are with the broad gauge, but we think the public safety would be endangered in employing the greater capabilities of the broad gauge much beyond their present use, except on roads more consolidated, and more substantially and perfectly formed than those of the existing lines.

"3. In the commercial case of the transport of goods, we believe the narrow gauge to possess the greater convenience, and to be the more suited to the general traffic of the country.

"4. The broad gauge involves the greater outlay, and we have not been able to discover, either in the maintenance of the way,

in the cost of locomotive power, or in the other annual expenses, any adequate reduction to compensate for the additional first cost.

"Therefore, esteeming the importance of the highest speed on express trains for the accommodation of a comparatively small number of persons, however desirable that may be to them, as of far less moment than affording increased convenience to the general commercial traffic of the country, we are inclined to consider the narrow gauge as that which should be preferred for general convenience; and, therefore, if it were imperative to produce uniformity, we should recommend that uniformity to be produced by an alteration of the broad to the narrow gauge, more especially when we take into consideration that the extent of the former at present in work is only 274 miles, while that of the latter is not less than 1901 miles, and that the alteration of the former to the latter, even if of equal length, would be the less costly, as well as the less difficult operation.

"We are desirous, however, of guarding ourselves from being supposed to express an opinion, that the dimension of four feet eight and a half inches is in all respects the most suited for the general objects of the country. Some of the engineers who have been examined by us have given it as their opinion, that five feet would be the best dimension for a railway gauge; others have suggested 5ft. 3in., 5ft. 6in., and even 6ft., but none have recommended so great a breadth as 7ft., except those who are more particularly interested in the broad gauge lines. Again, some engineers of eminence contend that a gauge of 4ft. 8½in. gives ample space for the machinery of the engine and all the railway requirements, and would recommend no change to be made in the gauge.

"We may observe, in reference to this part of the question, that the Eastern Counties Railway was originally constructed on a gauge of 5ft., and has since been converted into a gauge of 4ft. 8½in., to avoid a break of gauge; and we have been informed that some lines in Scotland, originally on the gauge of 5ft. 3in. are about to be altered to 4ft. 8½in. for the same reason.

"Whatever might be the preferable course were the questions now to be discussed of the gauge for an entire system of railways, where none previously existed to clash with the decision, yet, under the present state of things, we see no sufficient reason to suggest or recommend the adoption of any gauge intermediate between the narrow gauge of 4ft. 8½in., and the broad gauge of 7ft., and we are peculiarly struck by the circumstance, that almost all the continental railways have been formed upon the 4ft. 8½in. gauge, the greater number having been undertaken, after a long experience of both the broad and the narrow gauge in this country; nor must the fact be lost sight of, that some of these railways have been constructed as well as planned by English engineers, and amongst that number we find Mr. Brunel, the original projector of the broad gauge. Mr. Brunel was also the engineer of the Merthyr Tydvil and Cardiff Line, which is on the 4ft. 8½in. gauge; and we think that the motives which led to his adoption of the narrow gauge in that instance would equally apply to many English lines.

"We are sensible of the importance, in ordinary circumstances, of leaving commercial enterprise as well as the genius of scientific men unfettered; we therefore feel that the restriction of the gauge is a measure that should not be lightly entertained; and we are willing to admit, were it not for the great evil that must inevitably be experienced when lines of unequal gauges come into contact, that varying gradients, curves, and traffic might justify some difference in the breadth of gauge. This appears to be the view which Mr. Brunel originally took of the subject; for the Great Western proper is a line of unusually good gradients, on which a large passenger traffic was anticipated, and as it touched but slightly on any mineral district, it embraced all the conveniences and advantages of the broad gauge system, and was comparatively free from the influence of those defects on which we have commented; but such a breadth of gauge, however suitable and applicable it may have originally been considered to its particular district, appears wholly inapplicable, or at least very ill suited to the requirements of many of our Northern and Midland lines.

"In reference to the branches already in connexion with the Great Western Railway we may observe, that the greatest average train on the Oxford branch, for two weeks in July and October, was only 48 tons; on the Cheltenham branch, it did not exceed 46; between Bristol and Exeter, 53; and between Swindon and Bristol, it was under 60 tons. With such a limited traffic the power of the broad gauge engine seems beyond the requirements of these districts.

"We find, from an estimate furnished to us, and the general grounds of which we see no reason to dispute, that the expense of altering the existing broad gauge to narrow gauge lines, including the alteration or substitution of locomotives, and carrying stock, would not much exceed £1,000,000; yet we neither feel that we can recommend the Legislature to sanction such an expense

from the public monies, nor do we think that the companies to which the broad gauge railways belong can be called upon to incur such an expense themselves (having made all their works with the authority of Parliament,) nor even the more limited expense of laying down intermediate rails for narrow gauge traffic. Still less can we propose, for any advantage that has been suggested, the alteration of the whole of the railways of Great Britain with their carrying stock and engines, to some intermediate gauge. The outlay in this case would be very much more considerable than the sum above mentioned; and the evil, inconvenience, and danger to the traveller, and the interruption to the whole traffic of the country for a considerable period, and almost at one and the same time, would be such, that this change cannot be seriously entertained.

"Guided by the foregoing considerations, we most dutifully submit to your Majesty the following recommendations:—

"1. That the gauge of 4 ft. 8½ in. be declared by the Legislature to be the gauge to be used in all public railways now under construction, or hereafter to be constructed in Great Britain.

"2. That unless by the consent of the Legislature, it should not be permitted to the directors of any railway company to alter the gauge of such railway.

"3. That in order to complete the general chain of narrow gauge communication from the north of England to the southern coast, any suitable measure should be promoted to form a narrow gauge line from Oxford to Reading, and thence to Basingstoke, to, or by any shorter route connecting the proposed Rugby and Oxford line with the South Western Railway.

"4. That as any junction to be formed with a broad gauge line would involve a break of gauge, provided our first recommendation be adopted, great commercial convenience would be obtained by reducing the gauge of the present broad gauge lines to the narrow gauge of 4ft. 8½in., and we, therefore, think it desirable that some equitable means should be found of producing such entire uniformity of gauge, or of adopting such other course as would admit of the narrow gauge carriages passing without interruption or danger along the broad gauge lines."

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RETURN OF RAILWAYS IN GREAT BRITAIN, SHOWING THE GAUGES OF EACH.

(From Appendix to Report of Gauge Commissioners.)

| | | |
|---|---|---|
| Number of miles of railway completed in the United Kingdom ..... | | 2,264 |
| Of which on the wide gauge of 7 feet— | | |
| Great Western ..... | 118½ | |
| Cheltenham Branch.. | 42 | |
| Oxford Branch..... | 10 | |
| Bristol and Exeter .. | 76 | |
| Bristol and Glocester. | 27½ | ——274 |
| On the gauge of 6ft. 2in., but intended to be altered to 5 feet 3 inches— | | |
| Ulster ..... | | 25 |
| On the gauge of 5 feet 6 inches, but intended to be altered to 4ft. 8½ inches. | | |
| Arbroath and Forfar | 15½ | |
| Dundee and Arbroath | 16¾ | —— 32 |
| On the gauge of 5ft. 3in. | | |
| Dublin and Drogheda | | 32 |
| On the gauge of 4 feet 8½ inches ..... | | 1,901 |
| Number of miles of railways sanctioned in 1844 .. | | 787¾ |
| Of which on the 7ft guage | | |
| South Devon..... | | 63 |
| On the 5 feet 3 inch gauge (Ireland)— | | |
| Great Southern and Western ..... | | 122½ |
| On the 4ft. 8½ in. gauge .. | | 602¼ |
| Total made or sanctioned on the 7 feet gauge .... | | 366½ |
| Total made or sanctioned on the 4ft. 8½in gauge.. | | 2,503¼ |
| Number of miles of projects for which plans and sections are deposited at the Board of Trade for 1845 ..... | | 8,000 |
| Of which on the wide gauge of 7 feet..... | | 658 |
| Number of miles of railway comprised in bills which have passed the House of Commons, and seem likely to be sanctioned by Parliament in this session, about ..... | | 2,840 |
| Of which in Ireland on the 5 feet 3 inch gauge .... | | 772 |
| On the 7 feet gauge— | | |
| Bristol and Exeter, branches ..... | 29 | |
| Cornwall ..... | 66 | |
| Exeter and Crediton . | 5¾ | |
| South Wales ..... | 211 | |
| Wilts and Somerset.. | 129 | |
| | | 4403¾ |

| | | |
|---|---|---|
| Exclusive of the | | |
| Oxford and Rugby .. | 50½ | |
| Oxford, Worcester, & Wolverhampton .. | 97½ | |
| | 588 | ——5,88⅝ |
| Or, inclusive of the Oxford Rugby, &c.— | | |
| On the 4ft. 8½in. in gauge | | 1,628 |
| Grand total of railways made, sanctioned, or likely to be sanctioned, up to the present time, July, 1845:— | | |
| On the narrow gauge of 4 feet 8½ inches..... | | 4,131¼ |
| On the wide gauge of 7ft.. | | 777¼ |

### PLAN FOR CONSTRUCTING MARINE LIGHT-HOUSES.

Friend,—The number of lighthouses of various forms which have been destroyed on the Goodwin Sands has led me to consider whether lighthouses might not be constructed in such a manner as to preclude the possibility of their being injured by the action of the waves, and perhaps the following plan may be considered an improvement on the other system.

It seems that the aim of those engineers who have had the direction of such works has been invariably to construct a building, which, by its great strength would be able to resist the action of the sea during storms; and thus far to attain this end seems impossible, unless the building be placed on a firm foundation, such as the Eddystone. I think that in such places as the Goodwin Sands, a lighthouse might be constructed which would be secure from the effects of storms, but on the principle that instead of its having to resist the action of the waves, the water should pass *through* it, so that it would be literally a skeleton building. I would propose to build it by sinking six wrought iron shafts about twenty feet in the soil, leaving them of a sufficient height above, in order that the lighthouse itself, which would be placed on the top, might be secure from the effects of the waves. In order that the building should be of a considerable height, these shafts or pillars should be sunk in the sand by placing them in iron cylinders, which being made air-tight, a vacuum being formed inside, they would enter the sand by the pressure of the air, so that the cylinders should be of the height which the pillars would have to be sunk. The pillars being sunk to the required depth in such a manner as to leave the space between them much greater below than at the top, I would fasten them together with thick-wrought iron hoops or rings, and with bars crossing one another inside. An iron ladder might be constructed inside in such a manner as to strengthen the building, and as a considerable space would be left between the pillars, ring, &c., the waves could pass through without meeting with much resistance.

An additional protection for such, or, in fact, for other lighthouses, would be to place a very large circular floating breakwater around the building; these breakwaters should be built in the form of a ring, so that the violence of the waves would be considerably diminished before reaching the lighthouse. The main thing to be considered in this case is, whether the breakwater could be fastened with chains, &c., in such a manner as to prevent its getting loose, for in that case it would be the means of destroying the building instead of protecting it. A more detailed description of the *Skeleton Lighthouse* is not essential, as the principle will be easily understood.

I remain, respectfully,

JOHN DE LA HAYE.

London-road, Liverpool,
18th 2nd month, 1846.

### PREVENTION OF BOILER PRIMING.

Sir,—A few years since the Institution of Civil Engineers awarded a Telford Premium (or offered so to do) for "the cause of, and means of preventing, the priming of steam boilers." From this circumstance and the lapse of time one might have supposed that an efficient plan well suited to all circumstances would be now generally known. From the complaint, however, of W. H. (December 12,) it would appear that this is far from being the case.

Allow me to suggest, that where the proposal of a slide valve face (No. 1169, p. 13,) cannot be conveniently adopted, a shield, or plate of iron may be fixed inside the boiler, a few inches below the steam pipe with its edge turned up, leaving a narrow space, which, in the circumference of the plate should equal the area of steam pipe.

Where the boiler top is flat a shield of any shape will do; but for the round wagon boilers, the best way is to make it long and narrow, taking care to depress the middle so

as not to contract the passage about the steam pipe.

By applying a shield, as large as possible, of this description, the steam is diverted in its exit from the water in the form of a cone towards the pipe; and not only W. H.'s, but every steam boiler, under the most aggravated circumstances, will be perfectly free from priming.

I am, Sir, respectfully, your obedient servant,

A. K.

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Sir,—In the *Mechanics' Mag.* of Saturday, Dec. 12, "W. H." complains of his boiler priming to such a degree as to entirely stop his engine. I had a boiler constructed on the same principle, 2 feet in diameter, with 52 upright tubes, 1 inch diameter. I found the same practical drawback as "W. H." does, namely, the priming. I tried various means to prevent it. Tallow answered the best, but did not last long; so I took out the upright tubes, and in their place I put a fire-box and 12 iron tubes 2½ inches diameter, 4 feet 6 inches long, horizontally. I find the boiler answers exceedingly well, generating twice the quantity of steam with half the fuel that it did before, and not priming in the least. If "W. H." does not feel inclined to alter his boiler, then let him fix a pipe 2 feet long to the top of the steam-chest, and above it a ball about 9 inches in diameter of copper, or any other material calculated to bear the pressure, and by fixing his steam pipe to that he will find a very great difference. I should have adopted the same plan had mine been for land purposes instead of being fixed in a boat.

I am, yours, &c.

W. F.

Liverpool, Feb. 16, 1846.

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### THE PORTLAND VASE.

The following "Theory of the Construction" of this vase has been communicated to the Society of Arts by Miss P. Ensell. The authoress supposes that a jar of blue glass was formed in the usual way by the glass-blower, and its whole surface roughened, that the jar was then inclosed in a mould similar to those used for the formation of alabaster relievos, and that the jar and mould were finally exposed to the action of one of the petrifying springs of Italy, whereby a clear transparent substance was deposited on the vase, in such proportions as to form the figures in that beautifully white semi-transparent material which is exhibited in the Portland Vase. Mr. Doubleday (the gentleman who was charged with the restoration of the Portland Vase, and which is now in his charge,) gives a different account of the manner in which it had been formed:—The base, he says, is formed of blue glass, and has been made in the usual manner by the glass-blower; the white figures are also of glass, and are perfectly united with the base. The blue jar having been formed, was dipped into a pot of white metal, and so the lower part of it became entirely covered with a uniform coating of white glass. With some talent, and requiring some artistic skill, the white glass was then, by a process like that of gem engraving or cameo cutting, cut away in different forms and various thicknesses by the artist. Mr. Doubleday considers that not less than three or four years of continuous labour would be required in order to produce such a work of art in the present day.

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### CULTURE OF COTTON IN INDIA.

It will be in the recollection of our readers that a few years ago some American gentlemen were engaged by the East India Company to introduce the American cotton plant, and modes of cultivating it, into the Three Presidencies. A report of the results of this experiment was read to the Asiatic Society at their last meeting by Dr. Royle. The experiments were begun in the year 1840. Within the Bengal Presidency, a part of the north-west division of the country was selected; and though, at first, appearances were very favourable, yet the result was otherwise. The seasons were unusually dry during the years of the experiments, so that all the grain crops of those districts suffered very seriously. Dr. Royle, who has himself cultivated the plant in the Saharanpore Botanic Garden, thought that the culture would be successful wherever means of irrigation could be found. The planters were afterwards removed to Gorruckpore and Rungpore; but in those places the young crops were devoured by insects, and burnt up by the drought which followed the rainy season. The experiments are now carrying on in the neighbourhood of Dacca. In the Madras Presidency, there is already much native cotton cultivated; and the Bourbon plant was successfully introduced several years ago. The trials with the American cotton were made in Tinnevelly and Coimbatore. Occasional droughts and storms have here injured the crops in some degree; but upon the whole, the experiment has been successful; and the specimens sent home have been highly approved at Liverpool and Manchester. In the Bombay Presidency, the station of Dharwar was selected. This was the site of an experimental farm, where excellent cotton was raised in the year 1842. In this

place the plant appeared to answer perfectly; the cultivation has greatly increased, and the natives have adopted the new plant, finding it more profitable than their own. The gentleman who conducted the culture states that the climate is more like that of Mississippi than any he has seen in India. In this place, 600 acres were planted in 1842, 3,000 in 1843, and 6,000 in 1844. It was calculated that 15,000 acres would be in cultivation in 1845, and that the produce would be 1,000,000 lbs. Far from deteriorating, the seed appears to improve, and to resume part of its Mexican character. There is, thus, every prospect of a successful cultivation. The approval of the new culture by the natives is a favourable feature: many have bought the gins, and used them in cleaning their own produce; and as many places in the Southern Mahratta country have a climate and soil similar to those of Dharwar, there is little doubt that the Presidency will be the locality of an almost unlimited cultivation of cotton. In reply to queries sent to India by Dr. Royle, it appears that cotton may be bought at Hoogly at 1¼*d.* per lb., and that by making advances to the ryots, a reduction of 20 to 25 per cent. may be made on that price; also that the cost of clearing and conveying the cotton to the port of shipment would be under 1*d.* per lb.

## RECENT AMERICAN PATENTS.

[From Mr. Keller's Abstracts in the *Franklin Journal*.]

FOR IMPROVEMENTS IN REVERBERATORY FURNACES. *Claude S. Quillard.*—From the fire chamber of the reverberatory furnace, vertical flues are formed, through which the coal is fed, and in which it is prepared for combustion; between the two vertical feeders there is another flue, made pretty much in the form of an inverted funnel, for the purpose of supplying a portion of finely screened anthracite, to be dropped directly upon the burning coal, and which, spreading over its surface, will produce an immediate "blaze, or flashing up."

In front of the fire-chamber there are two ranges of flues furnished with registers, for regulating the supply of air. And for the purpose of removing the cinders, a set of pokers or a temporary grate is introduced through the air flues, to support the charge of coal whilst the grate is removed to drop the ashes, cinders, &c.

*Claim.*—"I am aware that vertical feeders in which the fuel to be burnt is brought into a state of ignition before it reaches the point where it is to undergo combustion, have been used for various purposes, and I do not, therefore, claim them as of my invention; but such feeders as those constructed by me, and herein described, have not been heretofore used in combination with a reverberatory furnace, or indeed with a furnace of any kind. I do claim, therefore, as of my invention, and desire to secure by letters patent, the construction of a reverberatory furnace in which anthracite is to be used as fuel with vertical feeders, constructed with feeding and with a flashing flue, and arranged and combined with such a furnace, in the manner herein set forth. Secondly I claim the combining with such a furnace, the draught holes furnished with registers or sliding plates, as described, and leading directly to the body of the burning fuel in that part thereof where the most intense heat is required. Thirdly, I claim the manner of clearing out the ashes, cinders, and other refuse matters by the aid of the forked or temporary grate bars inserted through the holes, in the manner and for the purpose herein described."

FOR AN IMPROVEMENT IN THE ART OF CASTING STATUES. *Lawrence Myers.*—The patentee says:—"My invention consists in making a model or pattern of wax, exactly corresponding with the object required to be cast, which I cover all over with a liquid blacking, composed of 1 pint of pulverized charcoal, 1 gill of rye flour, 1 gill of molasses, 1 gill of sour beer, which are to be well mixed together and then diluted with sufficient water to make it a rich liquid blacking, to be applied to the model or pattern, several times, as the weight of the casting may require. While the blacking thus put on is moist I apply my facing sand to the model or pattern, thereby causing the sand to adhere more firmly to the blacking."

*Claim.*—"Having, since my invention of the wax model or pattern, as before described, been informed that a model or pattern of wax has been used in foreign countries, I claim only as my invention and desire to secure, at this time, by letters patent, the mode of preventing oxidation of the surface of the metallic casting, and obtaining a finer and smoother surface, and deliveration of the figure by means of the aforesaid compound, or any other substantially the same, applied to the wax model, in the manner set forth."

## NOTES AND NOTICES.

*Scientific Coincidence.*—In 1815, Captain Smyth ascertained trigonometrically that the height of Mount Etna is 10,874 feet. The Catanians, disappointed that their mountain had lost nearly 2,000 of its reputed height, refused to acquiesce in the decision. Afterwards, in 1834, Sir John Herschel, who

was unaware of what Captain Smyth had done, determined by careful barometrical measurement that the height was 10,872½ feet—showing a difference of 1½ foot. Herschel called this coincidence a happy accident; but Dr. Wollaston well remarked that "It was one of those accidents which would not have happened to two fools."

*Echos.*—On the north side of Shipley church in Sussex, there is an echo which is said in certain states of the atmosphere, to repeat distinctly twenty-one syllables. The more famous echo in Woodstock Park repeats seventeen syllables in the day time and twenty at night.

*New Light.*—M. Gaudin, of the French navy, has invented a new light which he proposes to have on board ships, so as to prevent accidents at sea. The apparatus consists of a reservoir of oxygen, from which the gas flows under a pressure of mercury, and enters a flame produced by ether or spirits of wine through a small aperture at the axis of the wick, and the light thus oxygenated is thrown upon a piece of magnesia fastened to a thread of platina. The lamp in which these are placed has a reflector, and the whole is enclosed, with apertures for air, in such a way as to be safe from external injury. M. Gaudin is of opinion that this light may be applied with great advantage to railroad locomotives, as well as vessels at sea, and the expense does not appear to be at all in proportion to the important service that it would render.

*Rust.*—All the common metals, except tin, rust; they become duller and duller up to a certain degree, lose gradually their lustre, and then the process goes no further. Instead of this rusting being a destroyer of the metal, it is a preserver; for, even in the case of iron, which rusts quickly as compared with other metals, if it be dipped into tin, it comes out coated with it, and it is preserved beautifully. If iron be exposed for a couple of hours to the action of water, the iron becomes quite corroded; but when tinned, the iron is protected, and the tin itself appears unaffected. How is it that this metal can protect itself, and the iron that is under it? It is simply owing to the substance formed on the surface by the attraction of oxygen, which is so adherent to the metal beneath. It gives a protection which no varnish, or any other kind of application can afford. Take a copper or a tin plate, they are both protected in their metallic state by a thin coat formed in the first instance of oxide. It is only because this coat is so exceedingly compact, close, and adherent, that it passes for nothing—a mere film of tarnish. You think you see, or touch, a piece of tin; you cannot detect the film, except by close examination. We know it is there, but it is only by optical phenomena that we can measure its thickness. It seems clean and beautiful, but if you rub it off, you give the metal beneath a new character; the beautiful lustre, however, passes off the first moment up to a certain point. The body formed by the combination of oxygen with iron is different. The oxide does not adhere to the metal beneath; it forms upon it little spots, or porous tumuli. It is not an investing varnish, but the process goes on through the pores of the rust, especially if the metal be placed in a damp atmosphere. This is the reason why we find a difference between copper, iron, tin, and lead, when used for roofs, or other external purposes. The iron alone is eaten into and destroyed, by this want of adhesion in its rust to the surface of the metal. "It is curious to observe, in some cases, how tin, a metal having a slight attraction for oxygen, protects other metals from oxidation. In Canada, tin plate is used for the roofs of houses; I am told that you are dazzled by the lustre of the setting sun upon the roofs; and there, although it is exposed to the atmosphere year after year, it does not decay, because the superficial coat of oxide protects the tin and iron beneath."—*Faraday.*

*Lukium, or Turkish Plaster.*—The impervious and adhesive qualities of this composition, which is remarkably simple and durable, are so efficacious, that although some Taksim (tanks) are entirely beneath the earth, and thus perpetually exposed to outward infiltrations as well as inward pressure, and undoubtedly coeval with the earliest Byzantine monarchs, yet there is no record of their requiring repair, or of their having ever leaked. Water-pipes of burned clay or metal joined and coated with lukium, which, when dry, becomes as hard as stone, resist the effects of humidity for ages. The following is the receipt, as now used by the Lou Yolgee (Waterway-men):—Take 100lbs. of fresh kilned lime, finest quality, reduced to powder; ten quarts of pure linseed oil; and one or two ounces of cotton. Manipulate the lime, gradually mixing the oil and cotton in a wooden trough, until the mixture assumes the consistence of loaf-dough. Let it dry, and then break it into cakes for store or use. When required for the latter, take a sufficient quantity, moisten it with linseed oil, and with this paste give two or more coatings to the wall or pipes, allowing each coat to dry. Pipes of metal or clay can be hermetically joined by twisting well-carded hemp, saturated with lukium, round the interstices, and making it fast with cord also dipped in the mixture.—*Three Years in Constantinople, by* C. White, *vol. ii. page* 31.

*Khorassan or Turkish Mortar.*—Khorassan is used for the construction of mosques, reservoirs, and other buildings requiring extraordinary solidity. It is composed of one-third bricks and tiles, pounded to the consistency of road-scrapings, and two-thirds of finely-sifted lime, with the necessary quantity of rain-water. When employed, the mortar is laid on in layers of from five to six inches in thickness between each range of bricks or stones, the latter being dipped or sprinkled with water, to augment the adhesion. Khorassan, still in common use, was employed by the early Byzantines, as is proved by the remnants of their churches and cisterns. It was borrowed from the Arabs, who took it from the Persians, and called it Dakik ul Karf (Potter's Dust.) —*Idem*, vol. i. p. 312.

The *Scourge* steam bomb-vessel has been fitted with an electro-galvanic apparatus for transmitting communications from her paddle-boxes, or bridge connecting them, into the engine-room, whereby, in any kind of weather, day or night, the proper directions may be given to the engineers for their guidance, instead of the mode at present adopted of shouting down below, "Go on," "Ease her," "Back her," "Stop her," &c., &c. The apparatus being portable, may be moved to any part of the vessel, and is therefore not confined to the use of the officer on the bridge or paddle boxes; so that the steersman may have it, or the "look-out" forward.

*Glass Saloon.*—The Manchester Botanical and Horticultural Society propose to erect a new saloon in the gardens of Old Trafford, of sufficient size to receive the usual exhibition of flowers, plants, and fruit, and all the promenaders, and to be also available for lectures on botany, vegetable physiology, vegetable chemistry, &c. It is to be 150 feet by 45 feet; and 22 feet in height to the centre of the dome, or 32 feet to the centre of the dome ventilator. The whole of the front of this saloon is to be made of glass, and moveable, so that it may be removed in bright, hot weather. In short, the new saloon will have a back wall and two end walls, while the other side, and the whole of the domed roof will be of glass, covering an iron framework. Possessing an area of 6,750 square feet, or about 740 square yards, it will accommodate nearly 2,000 persons.—*Manchester Guardian.*

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# Mechanics' Magazine,

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## OXLEY'S PATENT EXPANDING SCREW PROPELLERS.

Fig. 1.

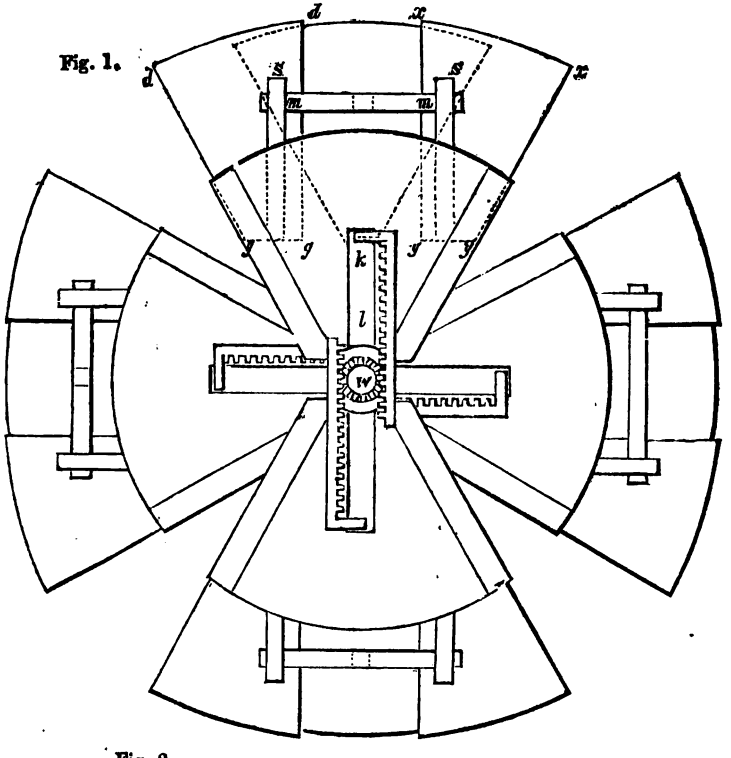



Fig. 2.

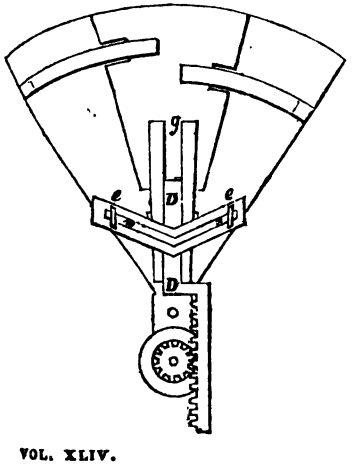



Fig. 3.

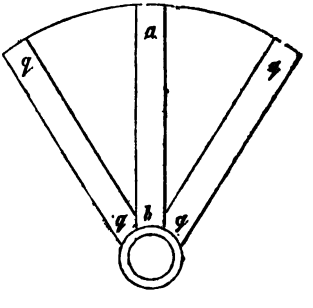
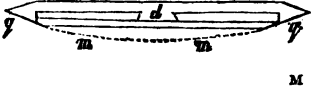


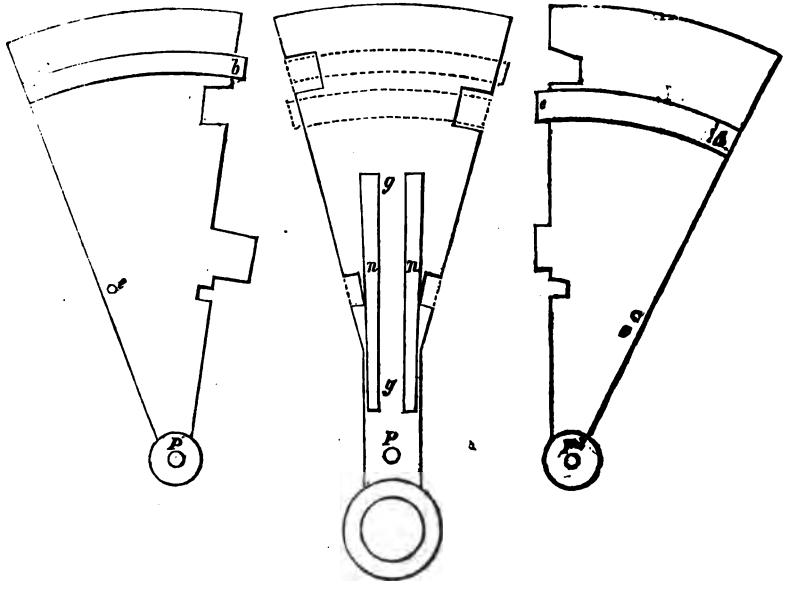

Fig. 4.



## OXLEY'S PATENT EXPANDING SCREW PROPELLERS.

[Patent dated August 21, 1845; Specification enrolled, February 21, 1846.]

Fig. 6. Fig. 5. Fig. 4.




A GREAT many improvements are comprehended under this patent—all relating to the important subject of "constructing and propelling vessels and the machinery connected therewith"—and we shall have frequent occasion to refer to it, before we shall be able to exhaust it of all the curious, valuable, and suggestive matter which it contains. For the present, we shall confine ourselves to a selection from a number of plans which have for their common object, the accomplishment of that acknowledged desideratum in screw propelling—a means of expanding and contracting the area of resistance at pleasure, according as a vessel has wind and tide in its favour, or a strong head sea to contend with. The general system devised for this purpose by Mr. Oxley is thus described:

"I make each segment or blade of two or more pieces or parts of suitable metal, one of which parts, or pieces, is made fast upon the propeller shaft, or axis, and called *the back piece* (no matter whether it be placed to face towards the rudder, or towards the fore-part of the vessel,) and the other piece or pieces, is, or are adjusted to move backwards, forwards, or sideways, upon the said back-piece, and is or are called *the front blade or blades*. There may be either one, two, or three, or more of these front, or shifting blades attached to one back-piece, and they may be actuated so as to increase the resisting area in breadth only, or both in length and in breadth."

The blades on this system may be either single, double, or triple expanding. In the accompanying engravings they are represented as of the triple expanding description. Fig. 1, is a front view of a propeller shaft with four such blades attached to it, and in their expanded state The following is the inventor's description of the details:—

"Each of these triple propellers has a lid, or cover, and the expanding blades are shut up therein like a sword in its scabbard. Fig. 2 has a back-piece which is separately represented in fig. 3; *a b* is a groove in which a dovetailed slider works, to which slider is firmly attached a central segment, *d*, *g*, *d*, *m*, *m*, (see fig. 2,) *q q*, *q q*, (fig. 2 and 3,) are two other grooves inclined sideways from the central line of the propeller, in which work feather-edged sliders, to

which the segments *a a*, *e e*, and *b b*, *c c*, (fig. 2,) are respectively attached. The dotted lines *b d n* and *a d n*, show that portion of the central segment which is covered by the two other segments; *h l*, is part of the groove in which the central slider works; this groove extends from *l* to K, and the slider itself extends the whole length of the central segment from *m* to *g*. R R, are two short connecting rods. A pivot fastened to the central segment passes through each connecting rod at the inner end, *m*. At the outer ends of the connecting-rods there are slots to receive the corner-parts of the segments $B^1$ and $B^2$, which move respectively upon pivots at *n n*. When, by the motion of the rack, the central segment is moved backwards and forwards, the two segments $B^1$ $B^2$ are, by means of the connecting rods, carried smoothly along their sliding pieces, keeping always in the grooves, *q q*, which preserve them in a parallel position to the central segment, and also to each other. (A similar arrangement to this might be usefully applied to produce parallel movements in the steam engine.) Fig. 4 is a section of the back and cover of the propellers, figs. 2 and 1; *c c* is the cover, and *q a q*, the back-piece. And here *a* shows the groove for the middle slider, and *q q*, the grooves in which the side-slides work. The dotted lines, *m m*, show how the back increases in thickness up to the shoulder part, by which it is fastened upon the propeller-shaft."

* * * * *

A modification of the plan described in the preceding extract, and which Mr. Oxley states to be, in his judgment, "a great improvement," is shown in one of the blades of fig. 1. Here—

"*m m* represents a thin metal bar which is made fast upon the other two segments, *d d*, *g g*, and *x x*, *y y*. At the end of the bar, near S, enough of the metal is cut away to let the bar, *m m*, work freely backwards and forwards; *l k*, is part of the cover cut away to let the end of the rack, *r r*, pass freely backwards and forwards when acted upon by a wheel, W, inside of the propeller shaft."

Various mechanical arrangements are described by which the racks and sliders may be actuated, but with these, as they may be varied in numberless obvious ways, it is unnecessary to detain the reader.

## NICHOLSON'S CENTROLINEAD—IMPROVED BY MR. JOPLING.

Sir,—In the early part of 1815, or the close of 1814, I had from the late Mr. Peter Nicholson one of his valuable centrolineads, and not long after that time I discovered a direct and more simple method of adjustment than that given by Mr. Nicholson, as described in your last Number.

I explained the circumstances to the late Mr. Tredgold, who had a centrolinead made with the view of simplifying it, having one leg only to move, the other fixed at right angles to the blade.

I explained my method both to architectural and other friends at the time; and I may mention that once being at Mr. Elliott's, in Holborn,—who some time ago recalled the circumstance to my recollection,—I explained my plan of adjusting the centrolinead to a person who was purchasing one, and who expressed much pleasure on receiving the information. My plan is as follows. Suppose the instrument and the given lines to be as you have represented:—

First, I put in one pin only; then with one leg against that pin, I place the blade to one of the given lines, and then at the inside of the other leg, I draw a line. Again, with the same leg against the fixed pin, I place the blade to the other given line, and then I draw another line inside the other leg, crossing the first line: where these two lines cross is the exact position for the other pin, which being put in, and the centrolinead being moved to and fro, the edge of the blade will coincide with both given lines, and of course draw any other lines converging to the same point. Thus, the adjustment is at once completed. There is also another advantage; the legs and blade being once set at any given angle with each other within the range of the centrolinead, many lines converging to points more or less remote, may be drawn with it—two fixed pins, being at a greater or less distance from each other; and these may be in different positions on the same, or any other drawing, which may sometimes be required to be carried on at the same time. The motion of this instrument is beautifully simple, and there is nothing more than practice required to understand it.

This motion is that of one case in the third division of my Septenary System, a full illustration of which would show, (at whatever angle the legs and blade may

be set,) the curves which any point in either, or in either produced, either way, may be drawn.

Your obedient servant,

JOSEPH JOPLING.

29, Wimpole-street,
24th Feb., 1846.

MISCELLANEA MATHEMATICA.—NO. VI.

*On the construction of trihedral angles.*

[We inserted at page 76, of the present volume, a letter from "a Student of Engineering" requesting a solution of this problem. Before giving, as we promised, that solution, it appears to us desirable to make a few preliminary remarks on the subject, which, we are led to hope will not be destitute of either interest or usefulness to the correspondent in question, and to others of our readers who may be similarly situated as to professional status.]

A trihedral angle consists of six parts; the three faces or plane angles, and the three bevels or dihedral angles. Euclid defines the dihedral angle, or inclination of two planes, by their bevel; that is, by the plane angle contained by the lines in which those planes are cut by any third plane profile to them. In the following solutions, therefore, we shall denote the plane angles by the term *faces*, and the dihedral angles are to be considered as measured by their *bevels* or profile angles.

As the *actual* construction of trihedral angles implies the actual placement of planes in positions which shall make specific dihedral angles, we are manifestly, unable to give a direct solution of the trihedral angle from having the magnitudes of three of its parts given.

One obvious mode of proceeding is to employ a spherical surface on which to construct the spherical triangle, whose sides shall be the circular measures of the angles of the three faces; and then, since it is known and easily established that the three spherical angles are measured by the three bevels of the trihedral angle (whose vertex is at the centre of the sphere,) the problem becomes virtually soluble. This is, in fact, the precise mode employed in the *trigonometrical* solution of the problem. For graphic and constructive purposes, however, this method is inadequate; as the practical constructions on a spherical surface become incapable of any degree of accuracy in their performance, whilst even a moderate approximation is attended with very considerable labour, and requires great delicacy of manipulation. It has hence been usual to construct even pure spherical problems by means of the projections of the several parts upon a plane. The orthographic projection has been sometimes used; but the stereographic has been found in practice the most convenient. The variety of scales, however, which this projection requires, and the great magnitude into which the spherical circles are often projected, renders this a most inelegant and inconvenient mode of solution. It is also unnecessary, as will presently appear.

Scarcely a shadow of the *doctrine*, and but very little of the *practice*, of stereotomy, have found their way into the literature of engineering of this country; and, indeed, Nicholson is, to the present hour, the only source of information open to the profession, both for constructive processes and graphic delineation. Certain traditional processes do indeed exist, and have long existed, amongst practical men and draughtsmen, adapted in a greater or less effective degree to the cases of most ordinary occurrence: but still many of these are wrong in principle, and all are given without a specific demonstration of their truth; whilst every new variety of the same general case offers new, or often inseparable difficulties, which admit of no solution but by constructing a tentative model, or by repeated and wearisome trials on a drawing. Does not this point out the *necessity* of a systematic course of education for the young engineer in the principles of *stereotomy*—or rather, of the more general and inclusive science of *descriptive geometry*?

The French architects had committed to print, at an early period, the processes which had been handed down to them, or which they had invented, connected with stereotomy. Before the close of the 16th century, appeared the work of De l'Orme; and during the following century the literature of the art was enriched by the writings of Jousse, Derand and Desargues. In the 18th century we find the productions of De la Rue, of Frezier, and finally, of the illustrious Monge. During all this time, our only

works worthy of the least notice were two on *perspective*;—that of Dr. Brook Taylor, remarkable for its generality of principle,—and that of Hamilton, remarkable for its elaborateness and accuracy. Other works, indeed, have appeared on this subject; but none of them possess any special merit, whilst they all bespeak authors who were destitute of every particle of genuine geometrical science. On the other departments of descriptive geometry, there is not urged even the pretension to have written a single treatise.

The editorial note (p. 76) was quite correct as to Hachette being the first to give a "complete solution" of the trihedral angle, in all its cases, and without calling in the aid of the supplemental trihedral angle. Frezier had, however, resolved with much elegance the case where the three faces were given to find the three bevels (see *la Théorie et la Pratique de la coup de Pierres et de Bois*. Ed. 2eme. tome i. p. 434;) and we have an impression, though we cannot at this moment refer to his work, that De l'Orme gives a construction not much different from that of Frezier. Legendre in his *Géométrie*, (liv. v. prob. 24) has also offered a nearly similar solution of that case; and (prob. 25) of the case where two faces and their bevel are given, to construct the other parts. These may be consulted in Sir David Brewster's translation of Legendre; or in Mr. Morton's Geometry of the Society of Useful Knowledge; into which they have been copied, p. 156. The entire solutions of the six cases given by Hachette, are also given in two American works on descriptive geometry: those of M. Crozet (1817,) formerly professor of engineering in the United States' Military Academy at West Point, and of Mr. Charles Davies (1828,) Professor of Mathematics in the same Institution; and these are, we believe, the only complete solutions which have been printed in our own language.

Hachette himself, though he gave independent solutions of all the cases, confined himself, for *practical* purposes, to the independent solutions of three of them, and founded the remaining ones upon these three by means of the supplemental trihedral. In fact, the solution of the case, where the three bevels are given to find the faces, is exceedingly operose in practice, and complicated in the demonstration; and as, to avoid this, we are compelled to use the supplemental trihedral in one case, it becomes more consistent, whilst it is equally convenient, to bring it into use in the two corresponding ones. This view has been taken by all the subsequent French writers on the subject; and we shall here, of course, likewise adopt it.

With a view to simplify the classification, we shall follow the same order with respect to faces and bevels that is usually followed with respect to sides and angles in plain trigonometry. They may be thus tabulated:—

| *Primary Cases.* | *Supplementary Cases.* |
|---|---|
| 1. Given two faces and a bevel opposite to one of them. | 1. Given two bevels and a face opposite to one of them. |
| 2. Given two faces and their included bevel. | 2. Given two bevels and their included face. |
| 3. Given the three faces. | 3. Given the three bevels. |

We have, indeed, often thought that this classification would greatly facilitate the memory of the cases of spherical trigonometry; and it appears singular enough that it has occurred to no one who has written on the subject.

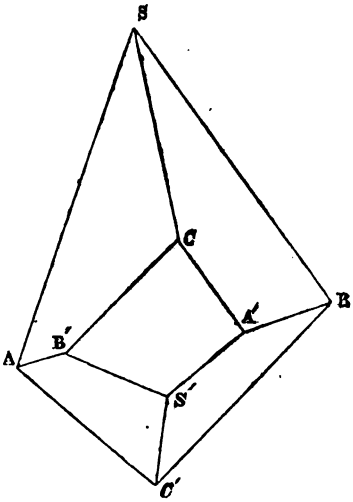
In the next number of the *Miscellanea Mathematica* we shall give the constructions of the several cases; and content ourselves, at present, with laying down the simple property by which the solutions of the supplementary cases are made to depend upon those of the primary ones.

THEOREM.—*If through any point in space, lines be drawn perpendicular to the faces of a trihedral angle, these will be the edges of a second trihedral angle, such that:*

(1.) *The faces of each trihedral angle are perpendicular to the edges of the other.*

(2.) *The bevels of each trihedral angle are the supplements of the faces of the other.*

(1.) Let S be the trihedral angle, and S A, S B, S C, its edges; also let S′ be the point in space from which perpendiculars S′A′, S′B′, S′C′, are drawn to the three faces, B S C, C S A, A S B; then the plane A′S′B′ will be perpendicular to S C, B′S′C′ to S A, and C′S′A′ to S B.




For let the planes through each pair of lines S′A′, S′B′, S′C′, cut the planes of the trihedral angle S in A B′, B′C, C A′, A′B, B′C, C A′.

Then, since the lines S′A′, S′B′ are perpendicular respectively to the planes, B S C, C S A, the plane, S′B′A′, is perpendicular to each of these planes (*Euc.* xi. 18); and hence also, it is perpendicular to their common solution, S C.

In the same way it is shown that S′A′C′ is perpendicular to S B, and S′C′B′ to S A. The three faces, then, of the trihedral angle S′ are respectively perpendicular to the three edges of S; and the three faces of S are respectively perpendicular to the three edges of S′ by construction.

(2.) Since C A′, C B′, are in a plane perpendicular to S C, the angles S C A′, S C B′, are right angles, and the angle A′C B′ is the bevel of the faces A S C, B S C. Also, since S′A′C, S′B′C, are right angles, the angles A′C B′, A′S′B′ are the supplements one of the other; and A′S′B′ is the face of the trihedral angle S′, opposite to the dihedral angle, whose edge is S C.

In the same way it will follow that B′S′C′ is the supplement of the bevel angle B′A′C, and that C′S′A′ is the supplement of the bevel angle, C′B A′.

By a mere interchange of the accented and unaccented letters in the detail of the above demonstration, the same reasoning will at once be seen to apply to in proof that the bevel angles of S′ are the supplements of the angles of the opposite faces of the trihedral angle, S.

*Scholium.*

The reader who is familiar with the doctrines of spherical trigonometry, will at once recognise in the theorem the cardinal property of the *polar triangle*. In spherics, however, the points S and S′ are coincident with each other, and with the centre of the sphere.

## HORNER'S METHOD OF CONTINUOUS APPROXIMATION.

Sir,—I must request you to insert in your columns a few remarks on the history of Horner's numerical process in correction of an inadvertence made in your account of my opinion on that subject, and in reply to the statement that Mr. Horner himself claimed no more than the process of transformation.

Nothing can be more handsome than the manner in which you have spoken of my attempts to elucidate this point of history. It is remarkable that before ten years have elapsed since the death of Horner, an individual should receive more acknowledgment for an account of the problem, than was ever awarded to himself, while alive, for his solution of it.

The opinion of mine, from which you dissent, as stated by yourself (p. 51), is "that Horner's method is only an extension of that of Vieta and the earlier algebraists." Now, this is not exactly my opinion. In the first place, the word *only* gives a sort of derogatory colour to the whole; whereas those who read my writings on this subject must see that I entertain a very high opinion indeed of the invention. There are those who think I rate it too high, and others who *did* so think, but do not now. I should never say that the man who turned a sledge into a carriage *only* invented the wheels.

In the second place, I do not call Horner's method an *extension* of Vieta's, but Vieta's method with a new process; which is precisely what you call it yourself, when you "accord all that is claimed for Vieta," with an exception which I will presently notice. In my article in

the *Companion to the Almanack*, and in the first two pages, in which I make a summary of what I mean to prove, Vieta is called an *extender* three times at least, while Horner is called the *discoverer of a new process*. In the article *Involution, &c.*, in the *Penny Cyclopædia*, in which there is no more of history than mere allusion, I find I have not used any term implying that Horner was an extender of Vieta. In the article *Vieta*, in the same work, it is said that Horner "reproduced Vieta's method with a *capital* improvement in the mode of making the necessary computations;" and the same is again alluded to as "Mr. Horner's new mode of conducting the calculation."

I carry my notion of the value of Horner's process much farther than you and many others who think highly of it. It appears to me to be a thing *per se*, of which the application to the solution of the equations is only a case. It is an organized mode of calculating the value of any algebraical expression, *by working from left to right*. It is an extension, but not of Vieta. It is an extension of the great arithmetical rules of division, and extraction of the square root, whether employed in solving equations or not; and even of multiplication when conducted from left to right. If all mathematical discoveries were placed together, in the order in which it were to be wished that they had been discovered, I think continued fractions[a] and Horner's process would far precede, in order of time, any other European discoveries whatever. And though Horner himself did not take so extensive a view of his own process, yet I consider him not the less to rank in the rarest class of discoverers, and to be the only one of his class whose name is known. Whether the others were Hindoos or Tartars, and whether they lived before or after the Flood, cannot now be ascertained; but they, whoever they were, invented division and the extraction of the square root; nor has their method received a single extension till our own time.

But to proceed:—In dissenting from my supposed opinion that Horner's process is only an extension of Vieta's, you argue that the idea of approximation was not Vieta's, and that, though you admit all that is claimed for Vieta, you do it with the understanding that the fundamental idea of approximation is not his. Now, first, even if I had advanced that Horner extended Vieta, it would have been no answer to prove that Vieta extended some one else. But, in fact, in the article already cited, and in the Summary, the very first two propositions enunciated are as follows; "that a method of evolution exhibited in the performance of division, and the extraction of the square and cube roots, was communicated by the Hindoo to the Arab writer, and passed from the latter into Europe." 2. "That an *extension* of *this* method to the solution of equations in general, laborious, but certain, was made by Vieta, &c."

Next, you suppose that the term *involution* appears to have been selected more from the accident of that article coming on in the *Penny Cyclopædia*, at the time when I was prepared to introduce the subject, than as descriptive of the process of gradual extraction; for which, you observe, *evolution* would be a more appropriate term. Surely, it would; and I use it accordingly; for my article is not headed *Involution*, but *Involution and Evolution*. Involution is the direct process extended from the formation of powers; and answers the question, what is $x^3+3x^2+2x$ when $x=17$. But *evolution* is the inverse process—and answers the question what must $x$ be in order that $x^3+3x^2+2x$ may be 5814. Neither was the term involution invented by me. Mr. Peter Nicholson was the first who extended the word; and his *Essay on Involution and Evolution* is a treatise on Horner's process. That essay is cited by me in the first page of my article, to show that Horner's mode of solution *had received* the name of evolution.

These, however, are smaller matters. I now come to the point in which we really differ. You assert "that Mr. Horner did not claim one jot in reference to this invention, beyond that of the *modus operandi* of approximating, and the development of the principles on which it rests." To which I reply, that Mr. Horner, though he claimed to have invented no more than he did invent—for I am fully certain that he re-invented Vieta's method—yet did claim *the whole method*. And this I have not the slightest doubt of proving to your full satisfaction.

[a] That is, supposing these really to have been European. See the *Penny Cyclopædia*, article *Figa Genitæ*.

In the first place, Mr. Horner himself is a credible witness: I do not mean as to his veracity merely—which nobody ever doubted, that I know of; but as to temper and discretion as well. His answer to Mr. Nicholson's hint, that he had seen *Budan*, is a sufficient specimen of both. Now, in his *Horæ Arithmeticæ* (*Leybourn's Repository*, vol. v. part ii. p. 39) he writes in large capitals, "I AM NOT INDEBTED TO ANY PERSON THAT *ever* LIVED FOR A HINT BEYOND WHAT I HAVE FAIRLY AND BROADLY STATED IN THE *Philosophical Transactions*." If then, as you state, "the only claim he made is the sole invention of *the process of transformation itself*," this assertion, with all its force of capital letters, is untrue; for he has not, in the *Philosophical Transactions* mentioned Vieta, or Harriot, or Oughtred, or any of those who gave the "*numerose exegesis*," nor has he made any allusion to this exegesis.

Further, it is observable, that he never cites any of the older algebraists. Some men mention names but little; Horner does so constantly. But though he refers to Halley, Simpson, De Gua, De Lagny, &c., &c.; he never names Vieta, Harriot, &c. Again, the paper in which the above declaration is made, is an answer to Mr. Holdred's claim. Now, if Mr. Horner had been aware of the existence of the old exegesis, he might, and would, have completely upset his opponent by stating the simple fact, that Holdred's method (before he copied Horner's own into his Supplement) was just the old exegesis. Instead of this, he treats Mr. Holdred throughout, as if he were the inventor of as much as is in the old method.

It seems, then, that Mr. Horner did not allude to the old exegesis in the paper which, as he solemnly declares, contains a fair and broad statement of every hint he ever received. It seems also that he did not mention it, when no more than a mention would have been necessary to overturn a disingenuous opponent. But my proof is not yet done.

The solution of an equation, with Horner's peculiar process, was called by himself and by his opponents the *non-figurate* method: all the others being *figurate* methods. The distinction means that the latter employs the coefficients of the binominal expansion (which are all figurate numbers,) as explicit multipliers, which the former does not. All the methods which employ figurate numbers, differ from Vieta's exegesis by no more than such ordinary changes of the mode of operation as the use of the binomial theorem introduces.

Now, Horner, whom you state to have never claimed more than the *process of transformation*, actually claims a figurate method, as well as the non-figurate method. "They speak," says he, in the *Horæ Arithmeticæ* already cited, "of my figurate method, as if it were identical with theirs." He claims, in fact, three methods, two of them figurate. So that he claims the whole of three differing methods, each of which involves Vieta's exegesis.

Of all the writers whom Horner ever named, the only one whom I can discover to have given Vieta's method, is De Lagny, who gave it in his Algebra. But Horner does not name De Lagny in his paper on *the* method; and I rather suspect, from contexts, that Horner's acquaintance with De Lagny was made through Halley's paper in the *Transactions* for 1694.

You seem to think that acquaintance with Vieta's method was a common thing. Since the publication of my paper in the *Companion*, which I find has attracted the attention of those who are interested in numerical solution, that method is certainly known to all such persons, (among whom are not included all mathematicians, unfortunately.) But in the quarter of a century preceding 1839, any mention of the exegesis was excessively rare. Mr. Peter Nicholson mentions it once. Mr. Barlow, in the preface of his Tables, gives a short account of it, from Lagrange. That the former knew anything of it except from the latter, I very much doubt. Hutton mentions it in a manner which shows that he did not understand it, as I have noted in my paper.

Horner's merit, as an investigator, is of course increased by his not knowing what had been done before his time. Nor is it diminished by restoring the *priority* of a part of his method to its proper owner. It is important to his memory that the whole question should be now fairly settled. If, by the neglect of his contemporaries, future antiquaries should be allowed to discover a part in Vieta, Harriot, Briggs, Oughtred, De Chales, De Lagny, Herigone, Wallis, &c. &c. &c., they may perhaps suspect, that the rest is somewhere else.

Hoping that the importance which some persons attach to the history of this method may lead some others to the practice of it,

I remain, yours faithfully,

A. DE MORGAN.

University College, February 21, 1846.

*Postscript.*

***Sketch of a demonstration of the peculiar process of Horner's method, or of his mode of changing $x$ into $x+a$ in a rational and integral expression.***

Assume the well-known arithmetical triangle, as it was called

1
1 1
1 2 1
1 3 3 1
1 4 6 4 1
1 5 10 10 5 1 &c.,

in which the coefficients of the several terms in the development of $(x+a)^n$ are formed. Write this so, that the rows which are now horizontal shall be diagonal

| | | | | | |
|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 2 | 3 | 4 | 5 | |
| 1 | 3 | 6 | 10 | | |
| 1 | 4 | 10 | | | |
| 1 | 5 | | | | |
| 1 | | | | | |

It will thus be seen, that each number is made by adding the one before it to the one above it. Head the process with 1, 0, 0, &c., and that which was the first row will be seen to follow from the new first row, by the same law.

Instead of simply adding the one before to the one above, multiply the first by $a$ before adding it, and moreover, instead of beginning with 1 as the first of the first row, begin with $p$. We have then

| | | | | | |
|---|---|---|---|---|---|
| $p$ | 0 | 0 | 0 | 0 | 0 |
| $p$ | $pa$ | $pa^2$ | $pa^3$ | $pa^4$ | $pa^5$ |
| $p$ | $2pa$ | $3pa^2$ | $4pa^3$ | $5pa^4$ | |
| $p$ | $3pa$ | $6pa^2$ | $10pa^3$ | | |
| $p$ | $4pa$ | $10pa^2$ | | | |
| $p$ | $5pa$ | | | | |
| $p$ | | | | | |

The final results, $p$, $5pa$, $10pa^2$, &c., are the coefficients of $x^5$, $x^4$, &c. in the development of $p\,(x+a)^5$. Had $p$ 0 0, &c. been extended to one cipher more, the final results would have given the coefficients for $p(x+a)^6$, and so on. Another such table, headed with $q$ 0 0 0 0 would have provided for $q(x+a)^4$; another, headed by $r$ 0 0 0 for $r(x+a)^3$, and so on. But there is no necessity to make separate tables; for one such formation, headed with

| | | | | | |
|---|---|---|---|---|---|
| $p$ | $q$ | $r$ | $s$ | $t$ | $u$ |

will provide the coefficients of $x^5$, &c., for the final arrangement of

$$p(x+a)^5+q(x+a)^4+r(x+a)^3+s(x+a)^2+t(x+a)+u.$$

The reason is, that there is nothing in the operation which causes the terms resulting from $p$ to be any way different on account of $q$, $r$, &c., taking the places of the subsequent ciphers. It is enough that there should be as many *letters* following $p$ as there were *ciphers* in forming $p(x+a)^5$.

That this is Horner's process is evident to all who know it.

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REGISTERING HORO-BAROMETER.

Sir,—In page 53 of the current volume I described what is a mere philosophical toy, and it is as well perhaps to mention, that it has no connection with the instrument which is the subject of the present communication. Some time ago I called the attention of your readers to the effect which would ensue upon the rate of a clock if a barometer were attached to the pendulum, and the column of mercury subjected to the influence of the atmosphere.

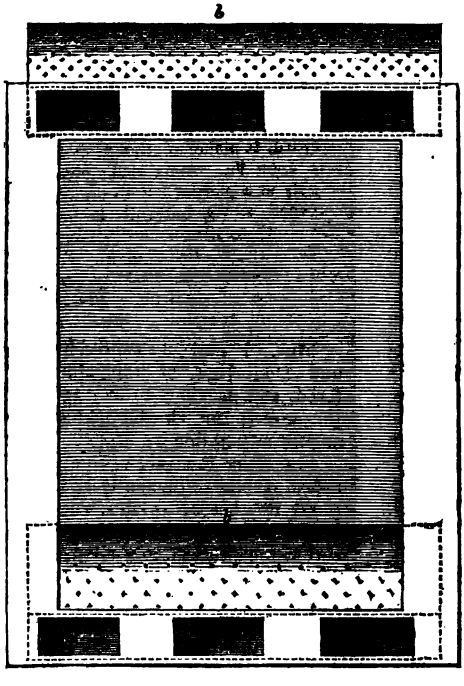
It is plain, that if we have a clock of this construction, the differential error from mean time at the end of every hour, will be a function of the accurate instantaneous average height of the mercurial column. All must admit, that the present method of deducing the mean pressure from observations taken at considerable intervals, is totally incorrect. For instance, if the height of the column is observed in the evening to be half an inch below that in the morning, we have no means at present of determining how long the height observed in the morning continued, and thus one mean daily column is calculated without reference to

proper distance for connecting 7; this done, commence heaving down, and as soon as the action of the screw has relieved the riding-pins, 1 and 2, withdraw No. 1 only. The upper *hole* in plate, as fig. 2, being sufficiently longitudinal (say ¼ of an inch) to give it freedom the moment the strain is off, No. 2 pin may be left in till the shroud is hove down as taut as desired, and No. 1 pin properly secured again to its advanced place. No. 2 is then shipped in advance and the part secured; on which the screw is "come up" and unshipped, and the guide-pin replaced. The operation on this shroud being now completed, the same process is continued to the rest of the shrouds successively.

I am, Sir, your obedient servant,
THOMAS BILBE,
(Foreman to Thomas King and Co., Ship-builders.)

Nelson Dock, Feb. 16th, 1843.

## DR. ALDIS'S VENTILATOR.



It is well known that the ventilators usually adopted cannot be kept open late in the autumn, winter, or early spring months, in consequence of the cold currents of air and unhealthy draughts which they occasion. It is also well known, that at these seasons the poor are in the habit of closing their over-crowded habitations, to such a degree, that the air becomes so vitiated as to cause the most

dangerous and fatal diseases. Numerous artizans who are in the habit of working in close shops or rooms in manufactories, suffer greatly from deficient ventilation, and especially one class, the tailors, are liable to consumption more from this cause than any other. To obviate these effects, as much as possible, Dr. Aldis has invented the ventilator represented in the annexed engravings. It consists of a hollow zink frame with a pane of glass in the centre. The upper and lower sides of the frame allow the external air to pass through openings, *c c*, made in them for that purpose, the air being conveyed in flattened tubes, *b b*, curved upwards, and freely perforated on their surfaces, so that an upward current of air is established, which diffuses itself over the room, and all direct draught is prevented. It will be found useful in houses of every class, nurseries, club-houses, hospitals, &c.

The manufacturers are Messrs. Cottam and Hallen, 75, Oxford-street.

## THE REPORT OF THE GAUGE COMMISSIONERS.

Sir,—As one of the mass of railway travellers, I conceive the greater ease of the broad gauge at high velocities, and its greater speed (admitted by the Commissioners) are most decided advantages both as regards the convenience and accommodation of passengers; though the Commissioners have decided to the contrary, in defiance of their own words.

Safety is a more difficult question, on which passengers' opinions may be considered of little value.

Are travellers of less importance than goods on railways, that their convenience and accommodation should be sacrificed in the West of England to the *belief* of three Commissioners, that the narrow gauge is more convenient for the transport of goods? Their document is most singularly strong in its recommendations, and as singularly mild in the expression of their opinions as to the safety, accommodation, or convenience, of either gauge for goods or passengers. Judging from their expressions, the opinion of the Commissioners seems to be in favour of the broad gauge for passengers, and of the narrow gauge for goods; but even here we have nothing more positive than their belief.

In an enquiry of this nature, where evidence has been chiefly collected from interested parties, the mass of evidence is likely to follow the mass of capital, and its quantity will be in favour of the narrow gauge, and the verdict given seems to be that the less ought to be sacrificed to the larger capital.

The finding of a verdict by a jury, if expressed in such terms as have been employed by the Commissioners, would seem to be obviously bad, because of its own internal contradiction, which affords in itself sufficient ground for a second trial before another jury.

I remain, your obedient servant,

S.

23rd February, 1846.

## THE "JANUS"—AGAIN!

Portsmouth, February 24.

The *Janus* steam-sloop went out yesterday morning with her noble designer on board, also Commander Coffin, of the *Scourge*, and Mr. Taplin, machinist of this dockyard, to make another trial of her engines upon the rotary principle. She left the jetty at a quarter before ten o'clock, and proceeded slowly out of harbour under steam, but not with her full power on. The *Rattler*, screw steam-sloop, Commander Smith, followed soon after, to attend upon her in case of accident. The *Janus* was lightened of everything which could safely be dispensed with, consequently her draught of water was so reduced that she was enabled to cut across the Spit bank, which shortened the distance considerably in making out; whereas the *Rattler*, although going at but little more than half speed, and compelled to round the anchorage of Spithead, gained so quickly upon the *Janus* that she gave her the go-by at the Lazaretto off the Motherbank, where soon after the *Janus* was compelled to lie-to to screw up some of her machinery, which had become deranged. Both vessels then steamed on for Southampton, where they moored for a short time, and then started on their return. The *Janus*, however, met with her usual luck, and broke the chain of her starboard wheel on coming down the Southampton Water, which compelled her to relinquish working the engine on that side the vessel, and hoist sail to assist her on her way home. She came into harbour about six o'clock, and the *Rattler* about half-an-hour before her. On this trip the greatest speed made by the *Janus* was 6 and 6 knots. She

started with 11½ revolutions, which increased to 16 per minute. Her speed under steam alone was 6 and 6. The result of the trial has proved that the *Janus* cannot be worked upon the rotary principle safely at present, nor long without disarrangement of the machinery. She is, of course, now *hors de combat*.—*Times Correspondent*.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65, FROM JANUARY 29, 1845, TO FEBRUARY 24, 1846.

| Date of Registration. | No. in the Register. | Proprietors' Names. | Address. | Subject of Design. |
|---|---|---|---|---|
| Jan. 29 | 639 | George Macfarlane .... | Gerard-street, Soho ..... | Improved valve for cornopeans, cornet à pistons, trumpets, trombones, &c. |
| 31 | 640 | James Kite..... | New North-road, Hoxton..... | Diamond deflector. |
| Feb. 4 | 641 | James Abbott..... | Brookhouse, Blackburn..... | Window-blind distending pulley. |
| 5 | 642 | Wm. H. Barlow..... | Derby..... | Designs for the shape or configuration of part of a railway chair for receiving the ends of two rails. |
| „ | 643 | E. Richson, M. A. Clerk, & Joseph Morgan, machine makers, | Manchester ..... | Conical inkstand. |
| 6 | 644 | Charles Pearce..... | Gresham-street, late Maiden-lane, London..... | Shirt front. |
| „ | 645 | George Fry..... | Lee-park, county of Kent..... | The West Kent garden-pot. |
| 7 | 646 | Alfred Foy..... | 28, Leicester-square, London ... | A combined day and night signal for railway lamp. |
| 10 | 647 | William Greaves, ironmonger, and W. T. Jones, carpenter ..... | Banbury, in the county of Oxford, and New-st, Covent-garden, Middlesex..... | Mangle. |
| 12 | 648 | Radford and son..... | Manchester..... | The Imperial parasol sliding joint. |
| 13 | 649 | Samuel Messenger..... | Birmingham ..... | Lens case and fastening for railway lamps. |
| 14 | 650 | James Parks and Son, | Birmingham ..... | Measuring-tape case as a pocket book, with leaves for memoranda. |
| 18 | 651 | Welch and Margetson, | 134, Cheapside, London..... | United collar and stock |
| 20 | 652 | Peyton and Harlow.... | 12, Panton-square ..... | Improved form of metallic slide and end rails for bedsteads. |
| 21 | 653 | Thomas Atkins..... | Gas Engineer, Oxford..... | The equilibrium window-sash |
| 24 | 654 | Joseph Wood..... | Surgical instrument maker, York..... | Dr. Torbock's apparatus for fracture of the leg. |
| „ | 655 | Peter Arkwell..... | Engineer, Stockwell-place, Stockwell, Surrey ..... | Gun. |

LIST OF ENGLISH PATENTS GRANTED BETWEEN JAN. 29, AND FEB. 25, 1846.

James Brown, of Balls-row, Hill-field, Coventry, for certain improvements in weaving. January 29; six months.

Augustus Turk Forder, of Leamington Priors, Warwick, solicitor, for an improved pump, or engine, for raising and impelling inelastic fluids, and producing motive power. January 29; six months.

Charles Cowan, of Valley-field-mills, Edinburgh, paper-manufacturer, for improvement in the manufacture of paper, millboard, and other similar substances. January 29; six months.

John Greenwood, of Church, Lancaster, manufacturing chemist, for certain improvements in dyeing Turkey red, and other colours. (Being a communication.) January 29; six months.

George Howell, Larkhall-lane, Clapham, Surrey, for coating with a metal the surface of articles formed of copper, or copper alloys, or iron, whether wrought or cast. (Being a communication.) January 29; six months.

Michael Rimington, of No. 10, Rufford-row, Islington, Middlesex, gent., for certain improvements in obtaining and applying motive power. (Being a communication.) January 31; six months

George Hinton Bovill, of Millwall, Middlesex, engineer, for improvements in the manufacture of iron. January 31; six months.

Andre Etienne, of Hatton-garden, London, gent., for improvements in the construction of railways, railway-carriages, &c., and in the means of preventing accidents on railways. January 31; six months.

James Pilbrow, of Tottenham, Middlesex, civil engineer, for certain improvements in propelling on land and water. January 31; six months.

Henry Highton, of Rugby, Warwick, master of arts, for improvements in electric telegraphs. February 3; six months.

Edwin Chesshire, of Birmingham, for improvements in apparatus to be applied to railway carriages, to reduce the prejudicial effects of collisions to passengers in railway carriages. February 3; six months.

Samuel Brown, of Gravel-lane, Surrey, gent., for

improvements in gas engines, and in propelling carriages and vessels. February 3; six months.

Thomas Foxall Griffiths, of Wolverhampton, for improvements in stamping and shaping sheet metals. February 3; six months.

William Garnett Taylor, of Halliwell, Lancaster, cotton-spinner, and William Taylor, of Halliwell aforesaid, labourer, for improvements in consuming smoke, and economizing fuel. February 3; six months.

William Milligan, of Bradford, York, manufacturer, for certain improvements in the power-loom. February 4; six months.

William Greener, of Birmingham, gun-maker, and William Edwards Staite, of Peckham, Surrey, esq., for improved means of ignition and illumination. February 7; six months.

Thomas Clarke, of Hackney, Middlesex, engineer, Mark Freeman, of Sutton, Surrey, gent., and John Varley, of Poplar, Middlesex, engineer, for certain improvements in obtaining and applying motive power, parts of which are applicable to the regulating and controlling of fluids. February 11; six months.

James Palmer Budd, of Ystalyfera Iron Works, Swansea, merchant, for improvements in the manufacture of iron. February 11; six months.

John Keating, of North Mews, Fitzroy-square, Middlesex, scagliolist, for certain improvements in the manufacture of cement. February 11; six months.

Joseph Pierre Gillard, of Rue Martignac, Paris, professor of mathematics and philosophy, for improvements in the production of heat in general. February 11; six months.

Charles Tetley, of Bradford, West Riding, York, stock and share-broker, for certain improvements in machinery for raising and impelling water and other liquids, and thereby obtaining mechanical power. February 11; six months.

William Edward Newton, of Chancery-lane, Middlesex, civil engineer, for certain improvements in the construction of instruments, or apparatus, for ascertaining, registering, and regulating the speed of carriages and machinery. (Being a communication.) February 11; six months.

Andrew Smith, of Princes-street, Middlesex, engineer, for improvements in coating or covering metals for the purpose of preventing oxidation. February 11; six months.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for certain improvements to be applied to the grinding of grain and other substances. (Being a communication.) February 11; six months.

James Murdoch, of Staple-inn, Middlesex, mechanical draughtsman, for an improved process for preparing a certain material for the purpose of painting. (Being a communication.) February 11; six months.

George Stephenson, of Tapton-house, Chesterfield, Derby, and William Howe, of Newcastle-upon-Tyne, Northumberland, mechanic, for an improvement in locomotive steam-engines. February 11; six months.

William Wharton, superintendent at the Euston-square station of the London and Birmingham Railway, for certain improvements in straps and bands. February 11th; six months.

Charles Rowley, of Birmingham, button manufacturer, for improvements in buttons, and other fastenings for wearing apparel, and in the machinery for manufacturing parts of the said fastenings. February 11; six months.

John William Stanbridge, of 38, Brudenell-place, New-road, Middlesex, gent., for an improvement in the manufacture of certain descriptions of silks and other fabrics. February 11; six months.

John Brochlehurst of Holborn, Middlesex, lamp-manufacturer, for improvements in the hanging and disconnecting of window-sashes and frames. February 11; six months.

James Nasmyth, of Arundel-street, Middlesex, gent., for certain improvements in engines, or machines for obtaining and applying motive power. February 16; six months.

William Edward Newton, of Chancery-lane, London, civil engineer, for improvements in the preparation or manufacture of thread, or yarn. (Being a communication.) February 16; six months.

Jacque Kloes, of Manchester, gent., for a certain improved combination of materials to be used as a substitute for leather, or for waterproof cloth, and other similar useful purposes. February 16; six months.

Juan Nepomuceno Adorno, of Mexico, gent., for improvements in manufacturing cigars, and other similar articles. February 17; six months.

Edouard Auguste Desire Guichard, of Rue des Feuneurs, Paris, for improvements in printing calico and other fabrics. February 17; six months.

Stephani Etievant, of Church-street, Soho, Middlesex, for improvements in stoves. (Being a communication.) February 17; six months.

Nicholas Francois Corbin Desboissierres, of Rue Saint Pierre Montmartre, France, gent, for improvements in preparing and burning fuel. February 17; six months.

Joseph Clinton Robertson, of 166, Fleet-street, London, civil engineer, for improvements in nail-making machinery. (Being a communication.) February 18; six months.

Robert Nisbet, of Lambden, esq., for certain improvements in locomotive engines and railways. February 19; six months.

Peter Claussen, of Leicester-square, Middlesex, esq., for certain improvements in machinery for weaving, and in preparing materials for weaving. (Being a communication.) February 20; six months.

George Alexander Thompson, of Connaught-terrace, Hyde-park, gent., and Joseph Wright, of Holborn-bars, mechanic, for improvements in propelling vessels. February 25; six months.

John Maddock, of Burslem, Stafford, earthenware manufacturer, for a new and improved method of building and constructing kilns and ovens used by potters and manufacturers of china and earthenware. February 25; six months.

Moses Poole, of London, gent., for improvements in cleaning and separating grain and other seeds. (Being a communication.) February 25; six months.

Antonio James Mayer, of Ashley-crescent, city-road, for improvements in certain wood-cutting machines. February 25; six months.

Josué Heilmann, of Mullhausen, in the Department du Haut Rhine, in France, machine-maker, for improvements in certain machines used for preparing to be spun cotton, wool, and other fibrous materials. February 25; six months.

William James Cantelo, of Paris-street, North Lambeth, for improvements in apparatus for hatching eggs, and raising the young, and for heating hot-houses, and other buildings. February 25; six months.

Thomas Pemberton, jun., of Birmingham, manufacturer, for a new, or improved method or methods of ornamenting window furniture and articles of upholstery in general. February 25; six months.

William Roberts on, machine-maker, of Gateside, Renfrewshire, for certain improvements in the machinery for spinning and twisting cotton, silk, wool, flax, and other fibrous substances. February 25; six months.

John Platt, of Oldham, Lancaster, machinist, for certain improvements in machinery, or apparatus, to be employed in the preparation and spinning of cotton, and other fibrous substances. February 25; six months.

John Britten, of Liverpool, chemist, for certain improvements in the method of applying heat, for the purposes of heating, cooking, and evaporating,

and in the apparatus connected therewith. February 25; six months.

Peter Bancroft, of Liverpool, merchant, for certain improvements in the method or process of refining and purifying animal and vegetable oils, and grease. February 25; six months.

John Harcourt Brown, of Brunswick-place, Barnsbury-road, gent., for improvements in securing letters, envelopes, covers, despatches, packets, and parcels. February 25; six months.

Thomas Murgatroyd Deard, of Stockport, Cheshire, engineer, for certain improvements in machinery, or apparatus, applicable to the furnaces, or fireplaces of steam-engines or other boilers. February 25; six months.

## LIST OF PATENTS GRANTED FOR SCOTLAND FROM JANUARY 22, TO FEBRUARY 22, 1846.

John Walker, of Manchester, Lancaster, silk manufacturer, for certain improvements in weaving or manufacturing piled cloths, or fabrics, and also improvements in machinery or apparatus for cutting the pile or nap of the same. Sealed, Jan. 26.

Thomas Worsdell, jun., of Brighton, Sussex, railway-carriage builder, for certain improvements in apparatus to be attached to and employed in connexion with railway carriages. January 27.

John Depledge, of the Thorncliffe Iron Works, near Sheffield, York, draughtsman, for a new metallic broacher. January 29.

William Henry James, of Fish-street-hill, London, civil engineer, for certain improvements in tubes, tubular plates and other vessels and vehicles used for holding or conveying fluids, and in the means of heating the same. February 3.

John Greenwood, of Church, Lancaster, manufacturing chemist, for certain improvements in dyeing Turkey red and other colours February 5.

John Hopkins, of Woolwich, Kent, for certain improvements in railways, and trams for railways and tramways. February 6.

Josiah Marshall Heath, of Winchester Buildings, London, iron-master, for improvements in the manufacture of cast steel. February 10.

Peter Taylor, of Holmwood, near Manchester, machinist, for certain improvements in machinery, parts of which improvements are applicable to drawing and propelling fluids, also for improvements in the construction of vessels. February 12.

José Heilmann, of Mulhaussen, in the department of Haut Rhine, France, machine-maker, for improvements in certain machines, and for preparing to be spun, cotton, wool, and other fibrous materials. February 12.

George Hinton Bovill, of Millwall, Middlesex, esq., for improvements in the manufacture of iron. February 16.

Charles Tetley, of Bradford, in the West Riding of York, stock and share-broker, for certain improvements in the means of raising and impelling water and other liquids, and also thereby to obtain mechanical power. February 17.

William Newton, 66, Chancery-lane, Middlesex, civil engineer, for certain improvements in manufacturing piled fabrics. (Being a communication from abroad.) February 17.

John Finlay, of Glasgow, Lanark, ironmonger, for a certain improvement or certain improvements in raising and lowering gas and other lamps, lustres and chandeliers. February 18.

William Eccles and Henry Brierley, both of the township of Walton-le-Dale, Blackburn, Lancaster, for improvements in the machinery or apparatus used in spinning. February 18.

## NOTES AND NOTICES.

*The Royal Steam Navy.*—Forms have been supplied to the commanders of all the men-of-war steamers, to be filled up and returned immediately, showing the actual state and efficiency of each vessel, stating the speed of the vessel in light and sea trim, number of miles distance the vessel will go when fully coaled and stowed, state of the boilers, engines, quantity of fuel, stores, ammunition, powder, state of hull and timbers, masts and spars, sea service qualities, weight of engines and boilers when in use, dimensions of cylinders, length of stroke, and other essential minutiæ.

*Opening of the Witton Park Iron Works.*—On the 14th inst., Messrs. Bolckow and Vaughan, the large iron-founders, of Middlesbro', tapped two of their new furnaces at Witton Park. For those unacquainted with the locality, it may be interesting to state that the Bishop Auckland and Weardale Railway (a continuation of the Stockton and Darlington Railway), about three miles west of Bishop Auckland, skirts the banks of the Wear, at an elevation of about 56 feet above the river. The point selected for the iron-works, is a large area of level ground at the foot of the sloping bank, and the raw material is passed from the railway at this elevation, so as to admit of a continuous descent from the first process, until it arrives at the foot of the hill, where it is discharged from the furnaces in a state of manufacture ready for market. At a festive entertainment given on the present occasion, G. H. Wilkinson, Esq., of Harperly, who presided, observed, that it had long been known that the Valley of the Wear was stored with exhaustless treasures of minerals, that iron ore, lime-stone (containing 96 per cent. of pure carbonate of lime,) coal of the finest quality, and well adapted for coke, were in juxta-position, that nature had superadded to that favoured locality, fire-stone, and fire-clay for the building of furnaces, &c., and he felt sure that if spirit and talent could give success, Messrs. Bolckow and Vaughan, with their extensive works at Middlesbro', the making of iron in their own hands at Witton Park, the making of their own coke at Woodifield, were the men who had every prospect of as abundant a measure as their best friends could desire. Mr. Vaughan gave afterwards an interesting detail of the number of persons whom the works would be likely to employ, &c. The valley of the Wear had often been spoken of for its beauties, but when he saw the smoke emanating from those tall chimneys he could not but exclaim that those beauties were much enhauced; the quantity of iron-stone required per annum for carrying on these operations would not be less than 62,400 tons, coal and coke 104,000 tons, and lime-stone 20,800 tons, the greatest portion of which they anticipate bringing along the Wear Valley railway.

*Errata.*—In Review of Captain Fishbourne, page 129, 1st column in line 3rd from bottom, *dele* "is." Page 134, 1st column, in note †, *for* "she was 'very much more weatherly' than the *Saint Vincent*," *read* "the *Saint Vincent* 'was very much more weatherly'"; page 136, 2nd column, line 1st, for, "*b c*," read, "*e c*."

☞ INTENDING PATENTEES *may be supplied*, gratis *with Instructions, by application (post-paid) to Messrs. Robertson and Co.* 166, *Fleet-street, by whom is kept the only* COMPLETE REGISTRY OF PATENTS.

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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE

No. 1178.] SATURDAY, MARCH 7, 1846. Price 3d.]

Edited by J. C. Robertson, No. 166, Fleet-street.


## OXLEY'S PATENT EXPANDING SCREW PROPELLERS.

Fig. 12.

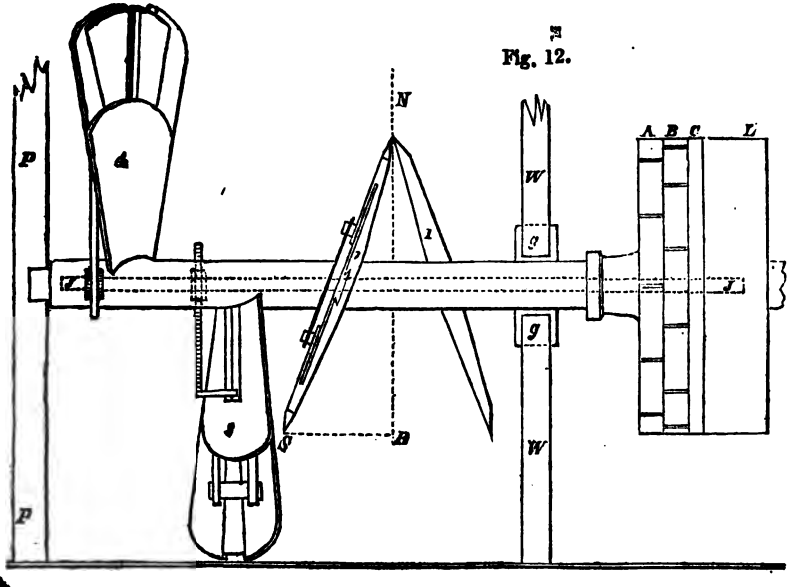



Fig. 13.

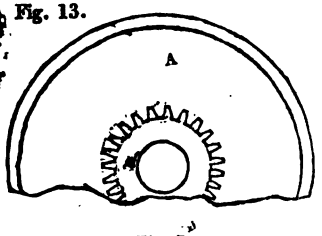



Fig. 14.

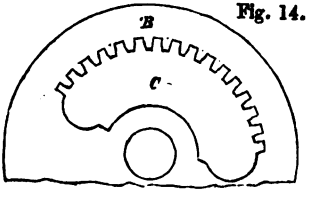



Fig. 7.

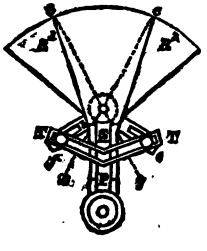
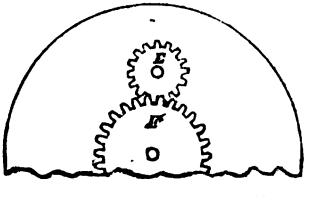


Fig. 19.



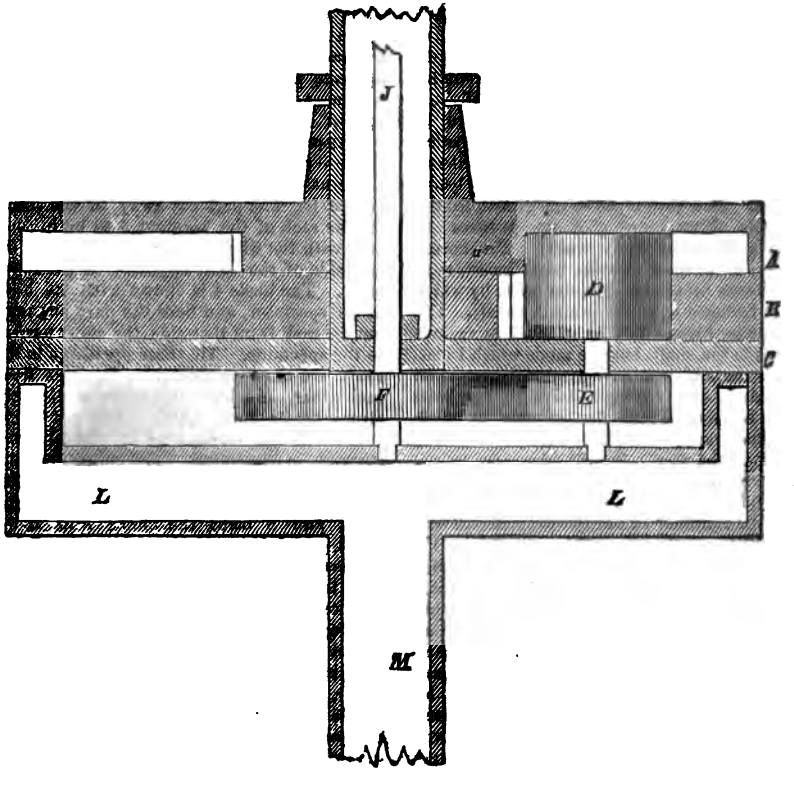
## OXLEY'S PATENT EXPANDING SCREW PROPELLERS—(SECOND NOTICE.)

THE account given of these propellers in our last Number was, through a mistake of our engravers, not altogether in accordance with the figures which accompanied it. The whole of these figures should have been a representation of Mr. Oxley's *triple* propellers; but part only were on that plan, and part on the *double* plan. As the best way of extricating the subject from the confusion in which it has been thus accidentally involved, we now give the remainder of the figures with the whole of that branch of Mr. Oxley's specification which relates to expanding propellers. In the course of the description, the figures given in our last Number will be distinguished from the others by the addition of an asterisk, as Fig. 1*, Fig. 2*, &c.

"In figure 1, I have given a plan in section of an expanding screw propeller on the above principle. A B C D is the propeller shaft, which it is necessary for the purposes of this part of my invention to make hollow, which shaft carries the propelling blades, or segments, P P, of which *f f* are the back, or fixed pieces, and *s s* the front or shifting blades. J J is a solid shaft fixed inside of the hollow shaft, A B C D, by means of which the shifting blades are actuated in manner to be next explained. On the inner end of the shaft J, there is fixed a bevel wheel F (fig. 1[a],) into which a smaller wheel or pinion, E, works, which is turned by a winch or handle, Y; these wheels, F and E, being enclosed in a drum or box, L L, through the top of which the handle of the winch, Y, is passed. On the outer end of the same shaft, J, there is fixed a bevel wheel W (fig. 1,) which actuates two pinions, *p p*, which work two endless screws *e e*. Each of these screws, *e e*, is borne at the outer end by an upright bearing F, and passes through a female threaded screw, *l l*. The uprights, F, are attached to the fixed pieces, *f f*, of the propeller blades, and their shanks pass through slots, or long openings, made in the sliding pieces *s s*, and are fixed to the back pieces *f f*. On turning the shaft J, by means of the winch Y, and the wheels E and F, the revolution of that shaft operating on the shifting blades *s s*, through the medium of the wheels W, the pinions *p*, and screw *e*, causes them to expand or contract according to the direction in which the winch is turned. Instead of giving motion to the expanding pieces of the blades by the means just described, the following arrangement may be adopted:—Let a pulley having strong projecting points of metal on its periphery be fixed in the same place as the wheel W; and another similar pulley at the end marked F. Then over these two pulleys let an endless chain be carried, through which an upright passes attached to the front or shifting blades *s s*. On the inner shaft, J, being turned this chain would be put in motion, the teeth of the pulleys would take into the links of the chain, and the sliding blades, *s s*, be made to move backwards and forwards as required. In figs. 2*, 4*, 5*, 6*, I have exhibited a *double expanding propeller* on the same principle as the preceding. Fig. 5* is a view of the back piece; *g g* is a groove formed by two strong side pieces of metal *n n*, and in this groove slides the guide piece or slider D D (fig. 2*.) Figs. 4* and 6* represent the shifting or expanding blades. To the front of the blades, figs. 4* and 6*, a strong piece of metal, *a b*, which I call the guard piece, is attached, and from *x* to *b* sufficient space is left between this guard piece and the blade, to let the back piece, fig. 5*, pass freely between them. I place the blade, fig. 4*, immediately next to or before the back piece, fig. 5*, and then next to fig. 4* I place the other shifting blade, fig. 6*, which has a guard piece similar to *a b*, which allows the pieces, figs. 5* and 4*, to pass between it and the blade (fig. 5*) to which it is attached. A bolt, P, fig. 5*, which serves as a common pivot or centre of motion, is passed through the holes P P, of the blades, figs. 4* and 6*, which turn upon it, and by having a broad head it holds them securely in their position. Upon this slide, D D, there is fixed (see fig. 2*) a V-shaped piece of metal having a long slot or opening, *w x*, in it, through which two strong bolts, *e e*, with flat heads are passed and firmly fixed to the sliding blades, figs. 4* and 6*. When the sliding piece, D D, is moved backwards or forwards, its action on the bolts, *e e*, causes the blades (figs. 4* and 6*) to which they are attached to be protruded or drawn in.

"Fig. 7 represents a modification of the expanding propeller last described. P *b c* is the back piece as before. The dotted lines, *b y* and *c x*, indicate the lines which divide the front or sliding blades, $B^1B^2$, down the middle of each. The blade $B^1$ has a leg or limb, *h f*, coming out sideways, being a few degrees in an angle to the line *b y*; and in like manner the blade $B^2$ has a

Fig. 20.




short limb, *q e*, projecting from it in the opposite direction. The pivot on which these expanding blades turn is at *n*; T T is a V-piece with slots as before described, which is made fast by bolts or pins, with broad heads to the legs *h f* and *g e*; or instead of this, the legs *h f* and *g e* may have slots in them, and the bolts or pins be attached to the piece T T. In either case the expansion of the blades, $B^1 B^2$, is produced by pushing the slide, P S, backwards and forwards. The motion to the slides may be given by any of the means before described, or by a wheel and rack. A single expanding propeller on this plan may be made by using one sliding piece and the back or fixed piece only.

"Two *triple expanding propellers* are represented in figs. 8 and 1*. Each of these has a lid or cover, and the expanding blades are shut up therein like a sword in its scabbard. Fig. 8 has a back piece which is separately represented in fig. 3*; *a b* is a groove in which a dovetailed slider works, to which slider is firmly attached a central segment, *d q d m m*, fig. 4*, *q q*, *q q*, fig. 3*, are two other grooves inclined side ways from the central line of the propeller, in which work feather-edged sliders, to which the segments *a a*, *e e*, and *b b*, *c c*, (figure 8,) are respectively attached. The dotted lines, *b d n* and *a d n*, show that portion of the central segment which is covered by the two other segments; *h l*, is part of the groove in which the central slider works; this groove extends from *l* to K, and the slider itself extends the whole length of the central segment from *m* to *q*. R R, are two short connecting rods. A pivot fastened to the central segment passes through each connecting rod at the inner end, *m*. At the outer ends of the connecting rods there are slots to receive the corner parts of the segments $B^1$ and $B^2$, which move respectively upon pivots at *n n*. When, by the motion of the rack, the central segment is moved back-

wards and forwards, the two side segments, $B^1$ $B^2$, are, by means of the connecting rods, carried smoothly along their sliding pieces, keeping always in the grooves, *q q*, which preserve them in a parallel position to the central segment, and also to each other. (A similar arrangement to this might be usefully applied to produce parallel movements in the steam engine.) Fig. 4* is a section of the back and cover of the propellers; *c c* is the cover, and *q a q*, the back-piece. And here *a* shows the groove for the middle slider, and *q q* the grooves in which the side slides work. The dotted lines, *m m*, show how the back increases in thickness up to the shoulder part, by which it is fastened upon the propeller shaft. The propeller blades may be attached in various ways to the shaft, but the mode which I consider the best, is to have parallel flanges upon the shaft, each having holes in it for bolts and screws. These flanges may be made all the way round the shafts, or only a part of the way. It will also add to the security of the propeller to have flanges extending lengthways on the shaft, making the shoulder end of the propeller to correspond exactly therewith. In figure 1*, four blades are shown in their expanded state, each being on the triple plan which has just been described; *m m* is a thin broad metal bar which is made fast upon the other two segments, *d d*, *g g*, and *x x*, *y y*. At the end of the bar, near S, enough of the metal is cut away to let the bar, *m m*, work freely backwards and forwards; *l k*, is part of the cover cut away to let the end of the rack, *r r*, pass freely backwards and forwards when acted upon by the wheel, W, inside of the propeller shaft. I consider this to be a great improvement upon the plan of propeller, fig. 8, because the cross-bar, *m m*, will keep much longer in good working condition in putting in motion the two side segments than would the pivots and connecting rods in fig. 8. The arcs, marked *u e*, show the magnitude of the propellers in their unexpanded state.

"Fig. 12 represents a longitudinal plan of a propeller shaft, with the propeller blades fixed upon it in the manner that I most approve of. P P is the stern post. I may here observe, however, that I propose using two of these screws on board of each vessel, more particularly if the vessel be a large one, and in that case, there must be two additional stern-posts, one to the right, and the other to the left of the common stern-post. W W is the wall of the bulk-head, on that part of it nearest the stern, and *g g* is a stuffing-box and bearings, through which the shaft works. A B C L L, is the drum before-mentioned, as enclosing the wheel gearing, by which the interior shaft, J, is worked. Here the propeller slides, 1 and 2, are shown edgewise. No. 1 shows the back edge, or is on that side of the shaft opposite the spectator. No. 2, is on that side next to the spectator, and displays the central and the two side segments, each in its expanded state. The segment 3 is on the lower side of the shaft, and the spectator sees what may be called the front or cover side of it. The part cut away in the shaft, for the rack of the segment 3 to be in contact with the wheel inside the shaft, is on that side of the shaft opposite to the spectator. The blade 4 is shown with its back to the spectator, and here the part cut away for the rack is on that side the shaft nearest to the spectator. All these openings in the shaft are at a considerable distance from each other, and leave the shaft sufficiently strong for its duty, which would not be the case if the four blades were all placed in the same plane of rotation. I determine the distance in manner following. From the point N of the blade 2, I let fall a perpendicular N R, and S being the chord line of the blade (which is here supposed to be equal to six feet) I call N S the radius, which gives 2·05 feet for the natural sine of the distance required, the blade being set to an angle of 20 degrees with the plane of rotation. The blades being fixed on in this manner, causes each blade to act upon a separate stratum of water, and though the blades may extend over a large arc of the circle the water-way can never be choked. My experience leads me to believe that a propeller, with the blades arranged in this manner, will possess a much greater power of propulsion than any other form or kind of screw propeller, where all the blades are huddled together on one part of the shaft, and are all placed in the same plan of rotation. Should it nevertheless be desired to have all the four blades in the same plane of rotation, then I would recommend that the propeller shaft should be made in the manner shown in figure 2. S S T V is the propeller shaft, W X W a toothed wheel inside thereof, and J a pivot on which this wheel turns. On the sides of the shaft just so much is cut away, and no more, than is sufficient to let the four little wheels, 1 2 3 and 4, be acted on by the inner wheel W X W; and then racks, as before described, are placed in contact with these little wheels. The dotted lines, *n m*, indicate the guard, or protector, through which each rack passes.

"I shall now proceed to describe the machinery whereby the blades can be expanded or drawn in during the time they are in motion by the engine power. A, (fig. 13,)

Fig. 1.

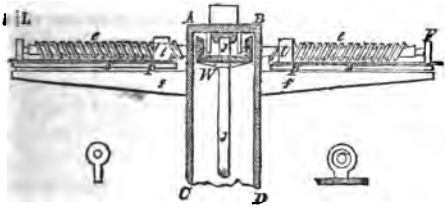


Fig. 8.

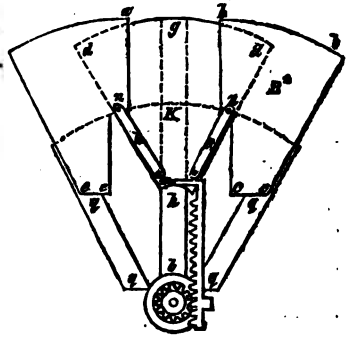


Fig. 2.

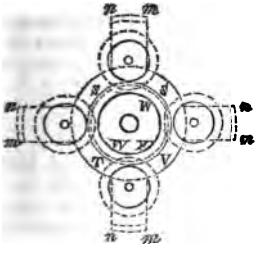
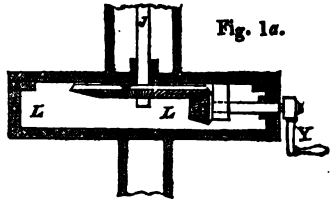


Fig. 1a.



represents a disk of metal with a flanged periphery, and $a^1$ a wheel in the middle of it, which is of the same size and the same number of teeth as the wheel, E. B., (fig. 14) is what I call a crescent wheel, because so, much of the metal of it is cut out as to leave the open crescent-like space C. The part of the wheel which circumscribes this space has a number of teeth cut on its inner face, that is pointing inwardly. A small wheel works freely within this crescent space. C, is a wheel which is firmly fixed on that end of the propeller shaft which is inside of the vessel. G is an aperture in the centre of it, which is of the same diameter as the interior of the shaft, and through this aperture passes the inner shaft, J, (fig. 20.) In fig. 19, F represents the wheel (fig. 17) which is fixed on the end of the inner shaft, and E the little wheel, (fig. 16.) The wheel E is fixed on the same arbor as the wheel D, (see fig. 20;) both being of the same diameter, and having the same number of teeth, only that D is twice as thick as E. Fig. 20 may be considered as showing the machine in section, where every part is represented in its proper place ready for action. Here P P is the end of the propeller shaft; B *d* is the crescent wheel, and $a^1$ the wheel $a^1$ of fig. 13. The wheel $a^1$ (fig. 13) is always in gear with that part of the wheel, D; which passes through and beyond the crescent wheel; L L is the drum, or box, which encloses the wheels E and F, and is firmly screwed or bolted on the part C; M is the continuation of the propeller shaft, which receives motion from the engine S. Across the peripheries of A B there should be some shallow notches made with a triangular file. The whole machine being put together, as explained under fig. 20, it exhibits the external appearance shown in fig. 12. By pressing a piece of cane, or of whalebone, or some other rather stiff but yielding substance against A or B, while the engines are driving the propellers, the resistance will cause A or B to put the wheels in the box or drum in motion, whereby the propeller blades will be protruded, or retracted, as desired.

"In the figures illustrative of the different varieties of expanding propellers before described, the blades are uniformly represented as being flat, but the same arrangements will in that case apply equally well where they are curved, or at least with such modifications only as any engineer of ordinary skill can readily supply."

### ANALYSIS OF A CHINESE METALLIC MIRROR.

*L'Institut*, 1845, p. 332, from *Erdman's Jour.* 1845, No. 8.—M. Elsner obtained by his analysis the following results:—

| | I. | II. |
|---|---|---|
| Copper, | 80·823 | 80·850 |
| Lead, | 9·389 | 10·038 |
| Anthmony, | 8·431 = 98·643 | 8·430 = 99·318 |

The mirror was a very perfect one, and was scarcely at all tarnished. It afforded a trace of iron but no arsenic. He suggests as probable, that in preparing the alloy equal parts of lead and antimony were employed, but that a part of the antimony was volatilized during the fusion.—*Silliman's American Journal.*

### THE SEPTENARY SYSTEM.

Sir,—During my school days, I received what is called "a good mathematical education;" and this was specially directed to my future professional destiny as an architect. Mathematics had, indeed, for me a peculiar charm; and probably but for the claims made upon my attention by the actual duties of my profession, I should have devoted myself wholly to that department of study. I have, however, acquired that general knowledge and power over the usual *methods* of inquiry, which not only enable me to understand most writers I meet with, but also to follow out such independent enquiries as may present themselves in the course of my professional practice.

As no one does, or can know the writer (except yourself *confidentially*,) this egotistic prelude cannot be supposed to be prompted by personal vanity. It is, indeed, a necessary prelude to the few remarks I am about to make—as I think you will presently perceive.

Amongst the subjects upon which my attention has been fixed, is that of Mr. Jopling's "Septenary System of Generating Curve Lines." All the descriptions, however, given by Mr. Jopling have failed to render the character of the instrument clearly intelligible to my understanding—both as regards construction and operation. Many, and curious curves are claimed by the inventor as resulting from the use of the instruments: but as far as I can perceive, our only reason for believing that the curves generated by his motions are of the kind which he alleges, is *his own allegation.* It is true that in one or two very simple cases his method appears to be identical with other and known genesis of simple curves; but with respect to the *general* description of curves, he has positively not given the shadow of a proof of the truth of his genesis. I have heard that Mr. Jopling complains of the neglect with which his invention has been treated; but it does appear to me that the *value* and *truth* of his system ought to be established by himself, before he calls upon the profession and the public to award him either praise or profit for the invention.

I am ignorant of Mr. Jopling's mathematical attainments; but it is fair to suppose that as he has devoted so much of his time to a subject so peculiarly geometrical as his system implies, he is conversant, at least, with the ordinary algebraical modes of investigating the nature of a curve from the relation of its co-ordinates, and the determination of its more delicate characteristic features, which the mere elements of the differential calculus so readily enables us to effect. This being presumed (and I would not be so offensive to any gentleman so situated, as to not presume it,) I would suggest to Mr. Jopling that he may, with comparatively little trouble, satisfy the public by such a plan as the following:—

1. Let him give *geometrical* descriptions of the fixed points, the moving or fixed lines, the intersections which generate the curve, &c., in the usual manner employed amongst mathematicians. It would bring the subject within the grasp of those who have tried in vain to unravel his descriptions of the instrument by the terms "crank," "tracer-plane," and others such as these.

2. Let him give the investigations of the *equations of the curves* related to some system of co-ordinates. This would at once unfold their general characters, and enable us to identify their respective species.

3. From the equations so obtained, let him determine the *constants* that shall give those curves which are required to fulfil defined purposes in the practice of architecture and engineering; carefully separating those which are merely

ornamental from all intrusion upon the class which relates to actual constructions.

4. Let him give, in the manner required in the first of these suggestions, the elements of construction of his *seven systems, taken in succession*. There is a notion afloat that they are but different disguises of the same real geometrical construction; and such a statement as is here proposed would serve to remove doubts that have operated much to Mr. Jopling's prejudice.

Mr. Jopling's writings seem to have made a general impression upon the public mind, that he considers the *eye* to be the true and only judge of the nature and character of a curve; I think, therefore, that as he claims a liberal degree of attention from the public to his invention, he is bound to satisfy the public upon those points which are essential to a determination of the value of his invention. I cannot, I will candidly say, bring myself to entertain the belief that any professional man would intrude any system upon the public, and pertinaciously urge it for a quarter of a century, whose mathematical investigations had not furnished him with an undeniable proof of all that he affirms concerning it. My wish is, that Mr. Jopling may meet the reward of his labours; and in order thereto, that he may render it intelligible to men like myself, and its advantages clear to all those for whose professed use it is designed.

I have no knowledge of Mr. Jopling personally, or I might personally make my suggestions to him; but as he is a frequent contributor to your Magazine, and as indeed the method itself was originally published through your medium, it seems the most advisable course for him to pursue, to express his views through the same channel. With cordial wishes for his success,

I remain, Sir, your obdt. servant,

CENTURION.

Home, March 2nd, 1846.

## DESIGN OF A CARRIAGE WHICH SHALL CARRY ITS OWN RAILWAY.

Sir, — Having been interrupted in some experiments which I was conducting with the view of perfecting what appears a useful invention, I beg the favour of your giving publicity to the following description of the essential part of it, that any amateurs or professors of practical science, who are so disposed, may contribute to render the contrivance of advantage to the public.

The object which I hoped to effect was, you will perceive, to diminish the surface-friction of wheels on sand, gravel, or bad roads generally, by providing them with adherent rails, which should always be interposed between the ground and the periphery of the wheels.

### *Description of a Wheelway.*

*(Of which imperfect models have been left at the office of the "Mechanic's Magazine," and the Polytechnic Institution.)*

It consists of twelve portions, each in immediate connexion with a twelfth part of the circumference of the wheel which it belongs to. Each of these portions has a plate of iron or wood, which presents a plane surface to the curvature of the wheel. This plate is connected with its section of the wheel by a semicircular staple, which moves on a corresponding segment of a circle, which is fixed on the side of the felloe. The staple and segment (or lug) thus admits of the plate lying passive on the ground without moving, while the section performs its part of the revolution of the wheel.

Every wheel of the carriage has to be furnished with the apparatus. In the brief explanation I am about to give, the words, "*anterior, posterior, &c.*" refer to the revolution of the wheel round the axletree, without regard to progression.

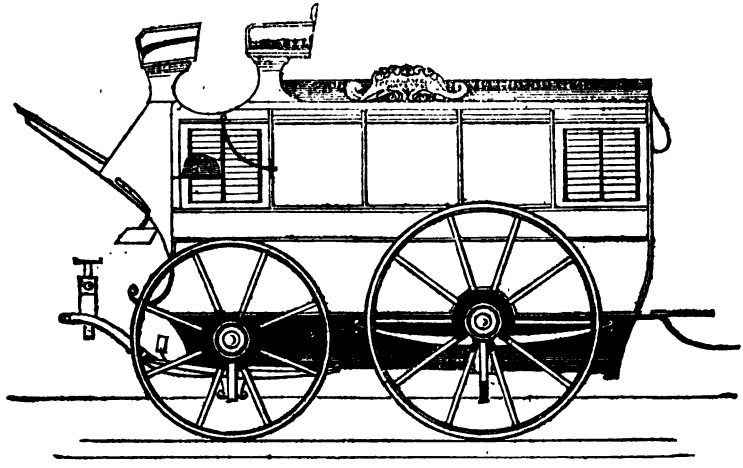
Suppose a carriage in motion,—when the first of the plates comes perpendicularly under the axle, the weight of the wheel passes from its anterior edge over the whole of it, to the next plate; and then lifting up the one passed over, the wheel carries it through the curve line, to be again deposited on the straight line of the cycloid. In this manner the twelve portions of the machinery are successively brought into action every time the wheel revolves; and the periphery of the wheel, running on the plates or rails, has not to encounter or surmount the irregularities of the road.

J. R.

March 4th, 1846.

*A Monster Steamer.*—An enormous steamer has been just launched at New York. She is named the George Washington, is three hundred and forty feet long, forty feet beam, (seventy-five feet wide, including guards,) and ten feet hold. She is to have 80-inch cylinders, and be fitted up in a style of unequalled magnificence.

## HUNNYBUN AND VENDEN'S PATENT SAFETY OMNIBUS.



It is surprising, considering the immense number of omnibuses now in use in every quarter, that so little endeavour has been made to study the convenience of passengers in getting in and out; all have to encounter high, and generally slippery and dirty steps; and not unfrequently accidents are occurring from passengers being thrown from the steps, by the horses suddenly starting forward.

The new omnibus, of which the prefixed engraving is an elevation, obviates all these objections by dispensing with steps entirely, while at the same time the carriage is improved in elegance of appearance, made much lighter in draught, and more convenient and roomy—so much so, that it is capable of seating comfortably three additional persons outside. Passengers may step with the greatest facility from the ground to the floor of the carriage, thereby avoiding all danger, and not requiring any assistance from the conductor. The ease of draught is effected by raising the fore-wheels at least six inches higher than usual. The frequent stoppage of omnibuses to take up or set down, render high wheels of the utmost importance to the horses, as they are much more easily set in motion again, than low wheels. An eccentric lock enables the carriage to be turned round within its own length.

The patentees have also introduced in the interior of the carriage roof what has been long wanted, namely, something to take hold of on passing along the carriage when nearly full. They have placed two brass poles, running from back to front, by means of which passengers may take their seats without the risk of being thrown into the lap of one another.

## THE WEST-KENT GARDEN-POT.

[Registered under the Act for protection of Articles of Utility. George Fry, of Lee Park, county of Kent, Gardener, Inventor and Proprietor.]

West Kent, famous as it is in the annals of horticultural competition, has hardly produced anything of more value to horticulture than the improved garden-pot, which has been named after it, and is represented in the above engravings.

Fig. 1 is an external elevation of the pot; and fig. 2, a sectional elevation.

In the bottom of the pot there is a hole (A) as usual; but it is of a much larger size, as will be seen from the figures, than in any pots hitherto made. B, is a drain cup which fits into, and completely covers the bottom of the cup; it has a small hole in it, *a*, which comes directly over the centre of the other hole, A; and is

Fig. 4.

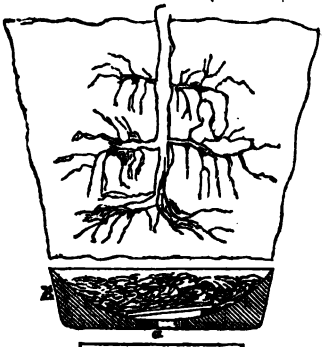
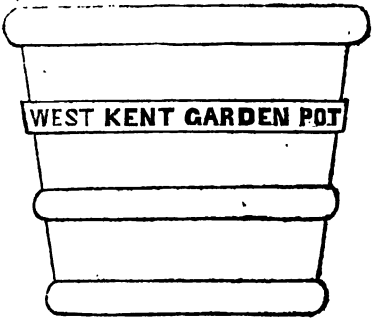
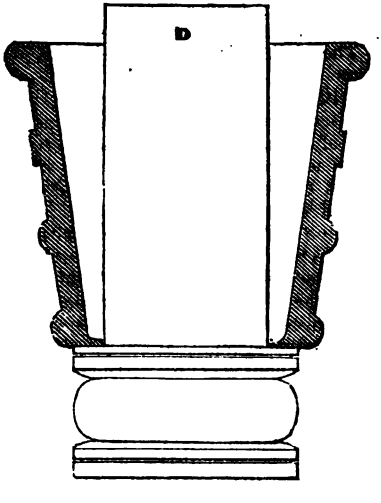


Fig. 1



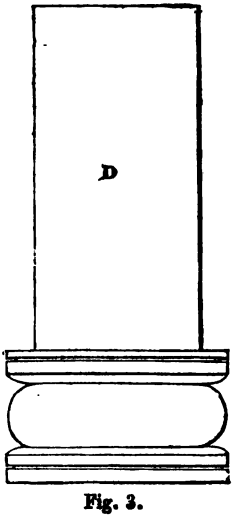




Fig. 3.

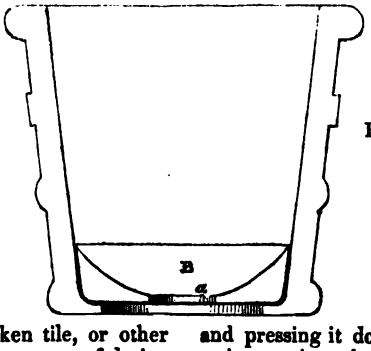



Fig. 2.

filled with pebbles, broken tile, or other materials suitable for purposes of drainage. D is an upright block, shown in elevation in fig. 3, which is detached from the cup, and of the same diameter as the hole A. By placing the pot, with its orifice, A, on the top of this block, D, and pressing it down upon it, the block acting against the bottom of the drain-cup, B, forces up the earth in the pot with any plant which may have been set in it, completely out of the pot, as shown in fig. 4, without the least disturbance to the earth or plant.

*The trihedral angle, concluded from page* 166.

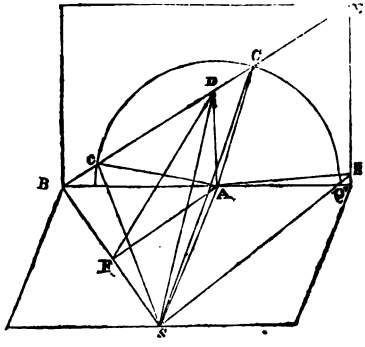
Before we proceed to the solutions of the several cases, we beg to make one remark in respect to a passage at p. 165. We have since observed, that in the suggestion which we made respecting the arrangement of the cases of spherical triangles, we have been anticipated by Mr. Davies, who in his edition of *Hutton's Course*, vol. ii. p. 55, has employed our proposed distribution of the problems, and, as thence appears, under the influence of similar views.

We may add, that the primary cases will be here denoted by I$\alpha$, II$\alpha$, III$\alpha$, and the supplementary cases by I$\beta$, II$\beta$, III$\beta$, respectively. We would also impress the reader with the advantage which he will derive from constructing a paper model of the trihedral angle, and of the lines and planes which are introduced into the analysis. His views will be rendered much clearer, and his conception more rapid by the adoption of this plan.

CASE.

*Given two faces, and the dihedral angle opposite to one of them.*

Fig. 1.




*Analysis.*—Let SA, SB, SC, be the three edges of the trihedral, supposed to be actually constructed; and that the faces BSA, ASC, and the dihedral angle opposite to the latter, are the data of the problem.

Perpendicular to the edge SA, common to the two given faces, draw the plane BE, cutting the three faces in the sides of the triangle ABC, and let the face ASC be revolved about AS as an axis, till it coincides with the plane of the face ASB in the position denoted by ASR, SR meeting BA in Q.

Then, since (*construction*) the line AS and plane BE are perpendicular to one another, the angles SAB, SAC, SAR, are right angles. But SAR being equal to SAC it is equal to SAQ, or R coincides with Q. Whence the locus of C, during the revolution of the angle ASC, is a circle upon the plane BE, whose centre is A, and whose radius is AQ.

In the next place, in the plane BE draw AD perpendicular to BQ, meeting BC in D; draw also in the plane ASB, the line AF perpendicular to SB, and join FD.

Then, AD is perpendicular to the plane ASB (*Euc.* xi. *def.* 4;) and the conditions are such as to render FD perpendicular to SB, (see the demonstration of *Euc.* xi.) Whence AFD is the bevel angle of the given dihedral angle.

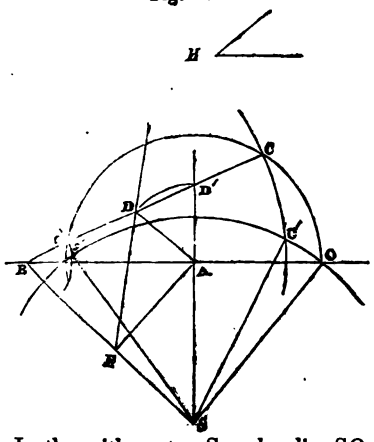
Let us conceive now, that the right angled triangle AFD is revolved about the line AF, into coincidence with the plane ASB. Then we shall have given the base AF and the angle AFD to construct the perpendicular AD, which is at once effected.

Conceive again, that the plane BE is revolved about AB into coincidence also with the plane ASB. Then the point B and line AB are given by the analytical construction, and the perpendicular AD by that which results from the analysis in the preceding paragraph. Whence the position of the line BD, in which the plane BE cuts the face BSC, is also given, and this line contains the point C.

The point C is also in the circle QC; and hence it is at their intersection. Moreover, all these constructions are performable on the same plane, viz., that of the face ASB.

*Construction.*—Let the angles BSA, ASQ, be the given faces, brought into the plane of the former, and H the bevel of the given dihedral angle opposite to the latter. Draw any line BAQ perpendicular to SA, AF perpendicular to SB, and AD parallel to SB, or perpendicular to FA. Make the angle AFD equal to the bevel of the given dihedral angle, the line FD cutting off the segment AD. Produce SA, making AD′ = AD; draw the line BD′, and describe about A the circle with radius AQ, meeting the line BD′ in C.

Fig. 2.




Lastly, with centre S and radius SQ, describe the circle QC, and with centre B and radius BC the circle CC′; and join SC′. Then, obviously, the three lines BC′, C′S, SB are equal respectively to the three lines BC, CS, SB, of the analysis, and the angle BSC′ therefore equal to that of the third face BSC.

*Scholium.*

It is clear that *in general* there will be two solutions arising from the two-fold intersection of the circle QC with the line BD′; giving thus either of the angles BSC′, or BSc′, as those of the third face of the trihedral angle. When, however, the line BD′ is a tangent to the circle QC, these two merge in one; and when they do not meet at all, the problem is rendered impossible from incompatibility in the data.

We may also remark that in practice it will conduce to distinctness of work, to sweep off the distances BC, Bc to meet the circle, QC′c′ to the *left* (as adapted to our figure) of the line SB. We have here merely aimed at the concentration demanded by the breadth of our page.

Further, we have not completed the solution by finding *all* the parts of the trihedral angle; but the problem is now reduced to either of the remaining primary cases, and its completion will be found in these solutions.

CASE Iβ.

*Given two dihedral angles and the face opposite one of them.*

Construct by I a trihedral angle, whose two faces are the supplements of the bevels of the given dihedral angles, and the bevel of whose dihedral angle opposite to one of them is the supplement of the given face. Then, by the property of the supplemental trihedral, the third face is the supplement of the third dihedral angle of the trihedral.

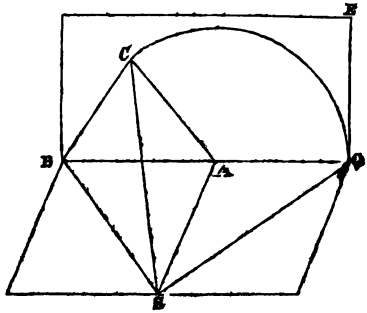
*Scholium.*

The same remark as to completeness applies here as in Iα; and for the same reasons, as the two cases are mutually dependent.

CASE IIα.

*Given two faces and their continued dihedral angle.*

Fig. 3.




*Analysis.*—Let S be the trihedral angle; SA, SB, SC the three edges, of which SA is that common to the two given faces ASB, ASC; and the dihedral angle contained by these be the given one.

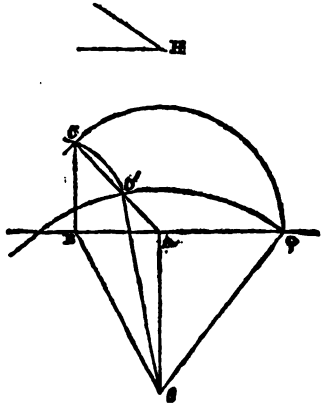
Let the faces of the trihedral angle be cut by a plane BE, perpendicular to SA, in the sides of the triangle ABC. Then, this plane being perpendicular to the intersection SA, of the planes ASB, ASC, the lines BA, AC, in which it cuts them, are at right angles to SA. Whence, BAC is the bevel of the given dihedral angle.

Revolve the plane ASC, about AS, into coincidence with the plane ASB; then, since the angle ASC is given, and AC is perpendicular to SA, the point C will always move in the plane BE, and describe a circle, QC, about A in that plane with radius AC or AQ.

Now, since AS, and the angle ASQ (=ASC) is given, the line AQ, and therefore AC is given, and CS=SQ. But if the plane BE be also revolved about BQ, into coincidence with the plane ASB, the whole of the lines in it can be constructed precisely as though it

retained its primitive position, and hence the entire construction can, as in the former case, be made in a single plane.

Fig. 4.




*Construction.*—Make ASB, ASQ, equal to the angles of the given faces, and let H be the bevel of their inclination; draw any line, BAQ perpendicular to SA. Make the angle ABC equal to H, and from centre A, with radius AQ, describe a circle QC, to cut it in C. Lastly, describe circles, from centre S, with radius SQ, and from centre B, with radius BC, to intersect in C′; then obviously the three sides of the triangle BSC′ are equal to those of BSC in the figure of the analysis, and hence, also BSC′, the third face of the trihedral angle, is found.

### Case IIβ.

*Given two dihedral angles and the face between them.*

In this case, make a trihedral angle, whose two faces, and the bevel of whose inclination are the supplements of the two given angles and of the bevel of the given faces: then, the third face of this, constructed as in II*α*, will be the supplement of the bevel of the third angle of the trihedral to be constructed.

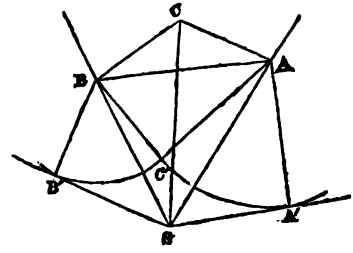
### Case III*α*.

*Given the three faces to find their mutual inclinations.*

Two methods are commonly employed in the solution of this case, in combination with each other. One consists in constructing the bevel of the angle opposite to the face upon the plane of which the drawing is made; the other in finding the inclinations of the two other faces to that face. By a *successive* application of either method, all the three angles may be found.

1st. Let it be required to construct the angle opposite to that face upon the plane of which the drawing is made.

Fig. 5.




*Analysis.*—Let SA, SB, SC, be the three edges of the trihedral angle. From any given point C, in SC, draw perpendiculars CA, CB to SC: then, these lines contain the bevel of the dihedral angle whose edge is SC.

Let the planes ASC, BSC, be revolved about SA, SB, into coincidence with the plane ASB: then, the angles ASC, BSC being given, the positions, SA′, SB′, which the line SC takes in these two cases are given: also, SA′= SC=SB′.

Again; since ACS, BCS, are right angles by construction, we have SA′A, SB′B, also right angles; and hence, the points A, B, are given, and likewise the line AB.

Moreover, AC=A′A is a given line; and BC=B′B is also a given line. We have, therefore, the three sides of the triangle ACB given, and consequently, also the angle ACB.

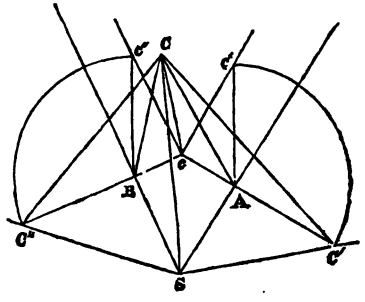
*Construction.*—Make ASB, ASC, BSC, as in the figure, equal to the angles of the three faces. Take SA′, SB′, of any convenient length, but equal to each other, and draw the perpendiculars A′A, B′B. Join BA, and with centres A, B, and radii AA′, BB′, describe circles meeting in C′: then the angle BC′A is equal to the bevel of the angle opposite to the face ASB.

By making angles equal to ASB to the right of SA′, and the left of SB′, a portion of the work already performed is rendered available to finding the other two bevels.

2nd. Let it be required to construct

the angles adjacent to the face ASB, upon the plane of which the drawing is made.

Fig. 6.




*Analysis.*—Let SA, SB, SC, be the three edges of the trihedral angle; draw the perpendiculars CA, CB, Cc, to the edges SA, SB, and plane ASB; join cA, cB, and produce them as far as any future constructions may render necessary.

Now, if the planes, ASC, BSC, be revolved about SA and SB, into coincidence with the plane ASB, the lines AC, BC, will coincide with AC′, BC″, the prolongations of cA, cB; and the point C, during these revolutions, will describe circles on the planes ACc, BCc, having A and B for their respective centres, and AC, BC, for their corresponding radii. Also, when the coincidences of the planes are made the angles ASC′, BSC″ will be respectively equal to those of the given faces ASC, BSC, and the lines SC′, SC″ also equal to each other.

Whence, if ASB, BSC″, C′SA, be the angles of the three given faces, and any distance, SC′, be taken equal to SC″, the point c is constructible.

In the next place, let the planes in which CcA, CcB are situated be revolved about cC′, and cC″, into coincidence with the plane ASB; then, in the two cases Cc will take the positions cc′ and cc″, perpendiculars to the given lines cC′, and cC″; and hence, in these two cases, C will fall in lines given in position. Also, since C moves in a given circle in the plane CcA, the point c′ will fall in the same revolved circle. Whence, as the radius is given equal to C′A, the circle itself is given, and therefore its intersection with the given perpendicular cc′ is given; and the triangle cc′A is given.

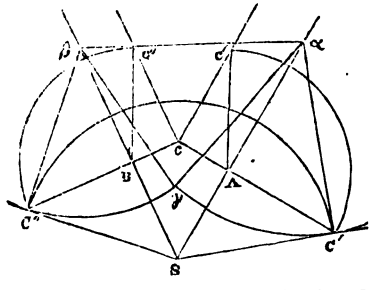
But the triangle AcC is equilateral to the triangle Ac′C: and hence the angle CAc equal to the given angle cAc′, and hence it is also given; and this is the bevel of the inclination of the faces ASB, ASC.

In like manner, as to construction and reasoning, the bevel c′Bc′ is given.

Make the angles ASB, BSC″, ASC′, equal to those of the given faces, and make SC′=SC″ of any convenient magnitude. From C′, C″, draw perpendiculars to SA, SB, meeting in c; and from c the perpendiculars cc′, cc″, to C′c, C″c; then with centres A, B, and radii AC′, BC″, describe circles cutting cc′ and cc″ in c′ and c″. Then drawing A′c, Bc″, the angles cBc′ cBc″ are the bevels of the two faces to the plane, ASB.

*Construction.*

Fig. 7.




The third bevel may either be found by making an angle to the right of SC′ or to the left of SC′ equal to the one not already used, and repeating the operation for the figure so transformed.

It will, however, be found more convenient to construct the third bevel by the first method, as nearly all the elements of construction are already made. The whole work is exhibited in the figure by means of the subsidiary lines from which is formed the triangle $\alpha\beta\gamma$.

### Case III$\beta$.

*When the three inclinations are given to find the faces.*

Construct a trihedral angle whose faces are the supplements of the given inclinations, and find its three angles. The supplements of these are the faces of the trihedral, which were required.

*Scholium.*

Since the foregoing solutions have

been in print, we have found a very simple method of constructing III$\beta$ without the intervention of III$\alpha$. As this removes the only reason for ndering the $\beta$ cases dependent on the $\alpha$ cases, we shall, at an early period, return to this subject, and give the *direct* solutions of the $\beta$ cases.

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### CIVIL AND MILITARY INVENTIONS.

[From an excellent article on the "Social Merit and Intellectual Condition of the Army," in the last Number of the *Westminster Review*.]

One invariable feature of the "military mind" is, its contemptuous rejection of every improvement in the practice of warfare that is proposed by a civilian. Even should a subaltern officer himself adventure in the march of improvement, it is rarely, indeed, that he can obtain the hearing of his superiors; and he must wait till he attains that rank in the army which alone can confer upon his invention its true military value. In reality it is a close approximation to an act of insubordination for him to see a defect where his superiors see none, or to conceive an improvement upon that which appears perfect in the eye of his commanding officer. As to the civilian, it is sheer impertinence for him to think he knows anything about rifles, percussion caps, the composition of gunpowder, or the structure of a fortress; and if he do not actually "get kicked for his pains," he is tacitly told to "consider" himself so. No civilian ever proposes a second invention to a military committee, or recalls the first to his memory without feelings of unmitigable indignation. It is true enough that military committees, like all other committees which are open to general application for the examination of inventions, will often be called to decide upon projects which are very worthless or very absurd; but it would seem that military committees are the solitary ones which never receive a single project that is worthy of a trial, or which might entitle its inventor to courteous or gentlemanly treatment! Still it singularly enough happens that inventions so propounded and so rejected, are *ultimately forced* into army use, from the mere disgrace of military missiles and military weapons being disreputably inferior to those of every sportsman and every amateur; of which the percussion cap, the army rifle, and its belted ball are familiar instances—and are all the inventions of civilians, which were for years rejected by military committees and military officers of high rank. So it will be with other inventions—rejected t present with insolent dogmatism and with- ut trial—they will be adopted, when a compromise with enlightened public opinion renders it expedient and necessary. We shall, however, yet see this farce upon a larger scale, as society progresses towards that last fearful struggle which will terminate in universal peace.

The Congreve and the Shrapnell were, we admit, the inventions of military men; but these inventions were duly and deservedly rewarded. We do, however, aver that very few of the great military inventions in present use were the inventions of *English officers*, though many of them are of *foreign* ones. Our military men never take the initiative, but are content to follow, far off, in the wake of their European competitors; and even now, as regards that important weapon, the rifle, we form a most degrading contrast to America. May our soldiers not be taught their helplessness on the wild prairies of Oregon! Defeat, indeed, seems to be the only kind of teaching which they can understand; but we are now getting our lessons tolerably fast and well—even from the sturdy savages of New Zealand. In fact, whenever any allusion is made to a military officer respecting the unscientific character of the English army, we get the characteristic and uniform reply—"Oh, sir, we are a *practical* people—we leave theory and that stuff to the French; but we adopt all their real practical improvements the moment we can get hold of them—why trouble ourselves with their science, then, since we always get the *cream* of it?" Now, as inventions which are effective for destruction can only become known to us as really effective from the heavy losses which we sustain from them; and as considerable time must elapse, and considerable slaughter of our troops take place, before we can dive into the secret; it does appear to our own plain minds to be more advantageous to us as a nation that we should substitute the labour of the mind at home for the carnage of our troops on the field of battle, in the discovery of these means of attack. But no! our authorities decide otherwise. Military men do not like to *think*, it being no part or parcel of the "Articles of War;" and their sense of honour would be incurably wounded at the bare idea of a civilian, other than the first minister of the Crown, thinking for them!

Yet the time is possibly not far off when this impertinent buffoonery of military etiquette must cease. The discoveries in science made during times of peace will change so many important features of practical warfare, as to render our routinists little better than "a flock of silly sheep" in the sanguinary contest. The transformations of strategy which will flow from the use of steam, both by sea and land, who can foresee? Where is

the imagination that can conceive what "infernal machines" may start up, like the seed of the dragon's teeth, even on the battle-field itself? Whole fleets may be annihilated by unseen means before their guns can range upon the destroying enemy; the proudest fortress may be reduced from distances which secure the besiegers from the loss of a single man; passes, invisibly mined, may be exploded from the distance of a dozen miles at a chosen instant, destroying in a moment half an army, and scattering the other half in irretrievable discomfiture. The very sense of inscrutable dangers concealed beneath their feet will make the men as inevitably cowards as the ides of supernatural interference did their mediæval fathers, and paralyze the few faculties which their officers may at other times possess; and even the ever daring, ever active, ever fertile Napoleon himself, were he alive to engage in the strife, would hesitate to attack a post whose defence was entrusted solely to a Professor Wheatstone! The English officer, therefore, *must* become a man of science, or he *must* seek the aid of the philosophical civilian; or rather, he must resign into such hands the supreme command, and content himself with the humbler and more fitting portion of his military duties—those of drilling and manœuvring his battle hosts, so as to render them the instruments of higher minds than his. War will hereafter become a contest between philosophers—a contest of invention and intellect.

## RUTHVEN'S MODE OF PROPULSION.*

[From the "Liverpool Times."]

On Tuesday last, we were very much gratified by witnessing a trial of Mr. Ruthven's model steam-boat, at the Rock Ferry, which had been introduced to the notice of the scientific, and others interested in steam navigation, by Mr. McQuie, at whose office this beautiful model has been on view during the last two or three weeks. The principle, or law, which has been made subservient as a propelling power by Messrs. Ruthven, the patentees, has relation to all fluid bodies. It has been ascertained that the discharge of a fluid, through an aperture or pipe, produces an internal pressure in an opposite direction to the discharge, and in proportion to the area and pressure employed.

In Messrs. Ruthven's model this principle has been very successfully applied, and some description of it may not be uninteresting to our readers.

Directly under the engine, and below the water-line, is a large circular iron case, into which a supply of water (received through a small aperture at the bow) is conveyed by means of a flat pipe laid on the kelson. The power of the engine is solely employed to revolve a fan wheel, inside this iron case, thus communicating a rotary motion to the water, which then passes towards the periphery of the case through corresponding apertures and pipes, communicating with two nozzles on the outside of the vessel (one on each side) where it is discharged above the water-line. These nozzles or bent pipes are so arranged that they may be turned by seamen on deck, so as to discharge the water either towards the bow or stern. When the nozzles are pointed towards the stern, the vessel is propelled forward; when towards the bow, she goes astern; when pointed downwards, she remains stationary. It is unnecessary to add, the engine requires not to be reversed or stopped during these operations.

Now, the advantages accruing from these arrangements are obvious and manifold.—In the first place, the hull of the vessel remains perfect, and her sailing properties not at all interfered with. A greater speed is attained with the same power than by the paddle-wheel or screw. There is no reaction upon the engine, therefore no vibratory motion is communicated to the vessel; the engine on this account may be made much lighter, as it is only subject to an uniform and regular strain. The vessel is rendered quite independent of her helm, for if one nozzle be pointed to the stern, and the other towards the bow, she will turn round as on a pivot. Should she spring a leak, the supply of water could be instantly cut off from the ordinary conduit, and taken from the hold. Many other advantages appear obvious in this simple application, and arrangement of a great principle, among which may be enumerated, that "as it is never requisite to reverse or stop the engine in cases of danger, emergency, or detention, so the tendency to explosion is avoided. Sails may also be used to any extent, either with or without the steam power."

Apart from all speculation as to the "theory" of the principle which is now admitted by all philosophers, the application has been eminently successful in "practice," as illustrated by the working of Messrs. Ruthven's model at the Rock Ferry, and also on a larger scale at Leith, where the patentees have a steam-boat, about 40 feet long, similarly propelled. The speed attained was very great in proportion to the power and size of the model, which is only 12 feet long, and too small to admit of any guiding or regulating it in its course; therefore, we cannot speak definitely as to the exact speed, but it seemed to be generally acknowledged about eight miles per hour at her highest power.

* For a former notice of this invention, illustrated by engravings, see *Mech. Mag.* vol. xl. p. 99.

### AN ELECTRICAL GIRL.

Angélique Cotton is aged thirteen, and a native of Finistère, where she was employed in a thread-glove manufactory as a winder. One day, whilst at work with her companions, the reel on which she was winding thread was suddenly projected from her. The circumstance excited surprise, the reel was replaced, when the same effect was renewed. It was then evident that Angélique herself was the cause. The affair made a noise in the village, and the curé was called in. It was supposed by them that she was possessed, and an exorcism was had recourse to, but no devil came out. After the priest, the doctor was applied to, but he was as unable to effect a cure as the curé had been. Another doctor then visited her, and witnessed the same effects as the other had seen, but being a sensible man, he made no attempt to cure an affection which he did not understand. This gentleman induced the mother of Angélique to send her to Paris, and accompanied her. A few days ago, she was taken to the Observatory, where Messrs Arago, Mathieu, Laugier, and Goujon, witnessed the following experiments:—A piece of paper, placed upon the edge of a table, was immediately attracted by the left hand of the girl. She then, holding her apron in her hand, approached a guéridon, which was pushed back, although the apron scarcely touched it. The next experiment was to place her in a chair with her feet on the ground. The chair was projected with violence against the wall, while the girl was thrown the other way. This experiment was repeated several times, and with the same results. M. Arago laid his hand upon the chair to prevent its moving, but the force was too great for his resistance, and M. Goujon, having seated himself on a part of the chair, was thrown off as soon as Angélique had also taken her seat. Such, said M. Arago, were the facts witnessed, and he had seen nothing to justify an opinion that any deception had been practised. Since then, other experiments have been performed by Dr. Tauchon. This gentleman had the chair in which Angélique was seated held by two powerful men. In this instance it was not driven away, but broke in their hands. A table, a guéridon and a heavy sofa were projected by the mere contact of the girl's clothes. Dr. Tauchon ascertained that the chair in which she sits is first attracted, and next repulsed. When Angélique is isolated from the ground by a glass stool, oiled silk, or any other non-conductor of electricity, the projections do not take place. A loadstone being placed near the left hand, which alone is magnetic, she experienced different sensations, according as the north and south poles were applied, and could tell with which pole she was in contact. She is repulsed by the north pole. She experiences violent commotions, when the electric discharges take place, and suffers greatly from them. It is in the evening, between seven and nine, about an hour after she has dined, that her electrical power is most strongly developed. Her pulse then beats from 105 to 120 per minute.—*Galignani's Messenger.*

### THE "GREAT BRITAIN."

"What has become of the Great Britain?" is a question which we hear frequently put, and have had frequently addressed to us. We now devote a corner to state what we know about her. The vessel is undergoing at Liverpool a thorough renovation of her machinery, previous to encountering the serious perils of another Atlantic voyage. If all we have heard be true, this renovation might more properly be described as an *entire reconstruction*. The Company of proprietors are now acting under the able advice of Mr. Field, of the firm of Messrs. Maudslay and Field, the constructors of the Great Western, whose performances, as a steamer, have never, as our readers are aware, been to this day surpassed. Well would it have been for the Great Western Company had they only contented themselves with building *just such another*, instead of aiming at a leviathanism, which was wholly uncalled for, and which (as the event has proved) was quite beyond the reach of any engineering skill possessed by those who planned and built her. We have reason to believe that when the machinery of the Great Britain, as it is now in the course of being altered, comes to be compared with what it was originally, such a series of blunders as to dimensions, proportions, &c., will be brought to light as the engineering public have rarely, if ever witnessed. How she should have been able, mis-engined and inefficient as she was, to make even the three halting voyages she did, is a marvel. Verily, it must have been of God's mercy that she did not share the fate of the unfortunate President.

*Dredging the Nile.*—The *Journal de Rouen* states that the quay of Mont Riboudet is at this moment covered with boilers and pieces of machinery, which are in course of shipment on board the brig *Philippe* for Alexandria, and are the different parts of a powerful dredging machine, ordered by Mehemet Ali of Mons. Cavé to be employed in removing the bars and other obstacles which at present impede the navigation of the Nile.

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## DESCRIPTION OF THE THERMANTIDOTE, OR EAST INDIAN COOLING AND VENTILATING APPARATUS.

Fig. 1.

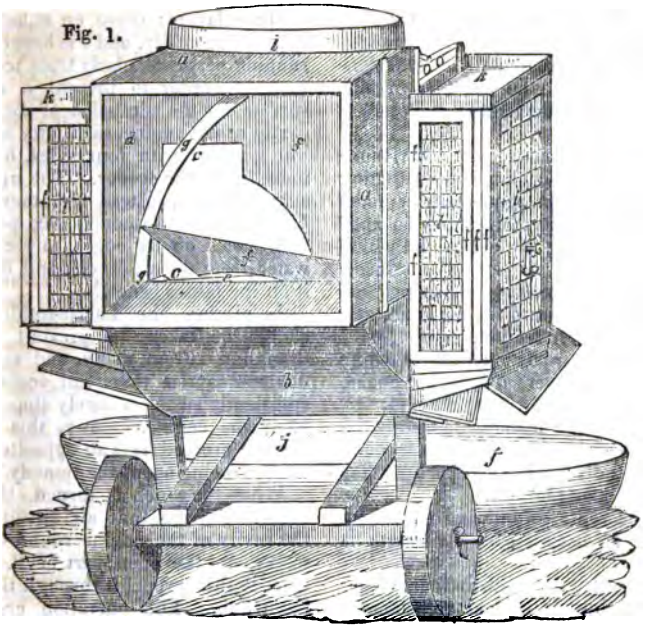
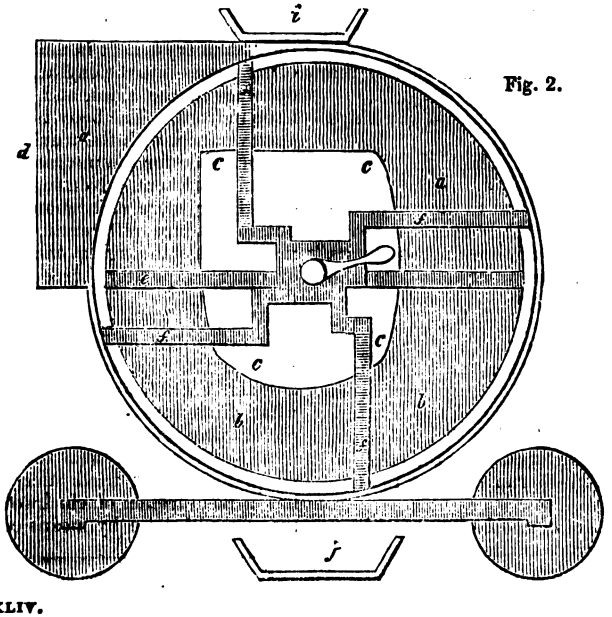


Fig. 2.



## DESCRIPTION OF THE THERMANTIDOTE, OR EAST INDIAN COOLING AND VENTILATING APPARATUS. BY JAMES RANKEN, ESQ.

[THE substance of the following paper appeared originally in the Transactions of the Medical and Physical Society of Calcutta. We now republish it at the request of the ingenious author, along with some additional particulars of considerable interest, which he has thrown into the form of a supplementary "Note."—ED. M. M.]

For ordinary houses, any contrivance capable of at once cooling and ventilating them, would be an acquisition of some value. I shall therefore make no apology for describing an engine by which these ends are at least partially attained.

Fig. 1 of the prefixed engravings represent an elevation of the machine, and fig. 2, a transverse section.

*a a a*, the upper portion of the machine fastened to the lower, *b b*, by six hooks, two on each side and two at the end.

*b b b*, the lower portion supporting the axle on a cross bar in each of the feeders.

*c c c c*, the feeders, or apertures for admitting air on each side.

*d d*, the vent, or blowing trunk, by which the air is expelled; its length is optional.

*e e*, the axle, armed with four wings, or fans; each wing rises at right angles from a projection at the middle of the axle; the intermediate space receives air from the feeders and yields it to be thrown out by the wings.

*f f f f*, wings or fans attached to the iron hoop.

*g g g g*, iron hoop fastened to the wings to keep them firm.

*h h*, a winch, by which the axle is turned.

*i i*, reservoir adapted to the top of the engine, which it slightly overlaps above the tatties from an opening, *o*, in its lower surface: the water falls into the box *k*.

*j j*, a similar vessel, without holes, receives the water beneath after it has passed through the tatties; a small pump wrought by the axle, or otherwise, answers well for raising the water; but native servants generally prefer lifting it in a bucket.

*k k*, a box perforated on the edges to admit the water to run down on the tatties.

*l l l*, tatties of *khus-khus*, secured by a framework, with an iron net-work beween, to be fastened to the feeders.

The "tatties" consist of double frames of wood, having a net-work of iron wire, between which the *khus-khus** is laid, in three layers: those on either surface lying horizontally, and one between them running perpendicularly from top to bottom. In order to present a sufficient surface for the admission of air into the cavity of the engine, each tatty is formed like a basket with four sides, having its mouth over the feeder. The uppermost side, however, instead of framework and *khus-khus*, is a wooden box perforated with holes on its edges, to receive the water from the reservoir, and distribute it on the tatties beneath.

In placing the Thermantidote, care should be taken to prevent contrary draughts. From many, and sometimes obvious causes, these will occur, and if sufficiently strong, entirely stop the blast from the engine. But as this must in general proceed from an opposite door or window being open, the remedy is easy.

When the winch is turned, the wings revolve, driving that air already within the cavity of the engine round the periphery, to the open part of the circle, whence they propel it through the blowing trunk. This operation creating a partial vacuum, the external atmosphere presses through the feeders to occupy the vacant space. As long, therefore, as the machinery is kept in motion, a stream of air passes into the engine, through the openings in the sides, and continues to issue in front. The body is placed in an open veranda, with the trunk penetrating a door, made for the purpose, and entering an apartment. Nothing more is required, for mere ventilation or fanning; but to produce refrigeration, the air is made to pass through a *khus-khus* tatty, or other evaporatory screen on each of the feeders.

Water descends upon the tatty, wetting every part of it, from one reservoir on the top, and is received into another beneath, none being lost, except what disappears in evaporation. The power may be variously applied: the wheel and pinion, and the wheel and strap, have been tried successfully, as has a modification of clockwork, raising the water likewise by means of a pump,

* *Khus-khus* (Andropogon muricata. *Linn.*)

connected with the axle. But projectors, who expect to be useful, must innovate with moderation. Mounted on wheels, and drawn by a horse, this engine was found to keep tents agreeably cool during the hot winds. Several of them are now in use at Delhi. For these two years I have myself employed them exclusively, instead of tatties and swinging punkas. Singly or combined, they admit of application on the largest or the smallest scale; and produce coolness or ventilation in proportion to their size and number. Should it meet with the approbation of the Society, I am of opinion, that the contrivance may contribute extensively to the health and comfort of all classes of Europeans in this country.

Those who have seen the fanners, or winnowing machine, will perceive my apparatus to be made on the same principles. In contemplating a new application of them, to refrigeration and ventilation, I found some difficulty in adapting the mechanism to this purpose. Yet in its present state, the engine produces sufficient cold for ordinary purposes. But depending on evaporation for its effects, these will vary according to conditions of the atmosphere, which nothing but a hygrometer can indicate. When extremely useful, during a calm in damp weather, it has very little effect on the thermometer. In the average state of the hot winds, it lowers the mercury from 90° to 70° in the shade. Last hot season, when the air was very dry, the instrument, under the double roof of a tent, fell from 104° to 80° by the influence of the engine. Taken into the veranda it rose to 110°, and when replaced in the current of air, it sunk again to 80°. Such results, however, which may be regarded as a maxim, are produced only at the mouth of the blowing trunk; since the air gets progressively heated after passing through the feeders. The range of the blast will depend much on the form of the apartment. The labour of one man in a wide room, makes it distinctly felt at the distance of 40 feet; and with its whole strength, augmenting the velocity of the wings, it will go twice as far. I have no doubt, that the current from it would circulate, under moderate exertion, through a veranda or corridor of 10 feet in breadth, and 40 yards long, if the side doors were closed.

So little is absolutely new in modern science, that it is not wonderful to witness daily contentions for the honour of trifling discoveries. Should any one think it worth while to claim priority of conception in this instance, I shall contend for nothing but previous ignorance of his right. I have never seen any machine resembling the contrivance in question, excepting that which has already been mentioned as its prototype.

*Note.*

The Thermantidote has been extensively used in India, wherever the hot wind prevails, for these last twenty years. The only objection made to it, is that the original cost is considerable (from 6*l.* to 10*l.*,) and that the constant labour of one man with occasional assistance of another, is required to keep one of the smallest dimensions in operation. Those who can afford the expense, and like the trouble to see the machine kept in working order, find it capable of thoroughly ventilating and cooling an apartment.

As physicians are of opinion that the contact of water causes air to precipitate or part with the foul exhalations which constitute the malaria, Mr. Ranken expected the wetted skreen of odoriferous roots (called a tatty,) to have similar effect; and recommended the Government of India to try his contrivance instead of the imperfect means still relied on for cooling barracks and hospitals during the hot season. He proceeded so far, as to show by actual experiment, that the apparatus was in every respect suited to the purpose, but did not persevere long enough to overcome interested opposition and the prejudices of those well-meaning functionaries who always dislike innovation.

A measure so obviously calculated to promote the health and comfort of European troops in a burning and unwholesome climate occurred spontaneously to Lord Ellenborough. When his Lordship first arrived in Upper India the hot-wind was blowing, and the house provided for his accommodation at Allahabad, was cooled by Thermantidotes. Perceiving their efficacy he ordered the executive engineer at the place to prepare an estimate for two of gigantic size, which, worked by steam, were to propel currents of cooled air from end to end of a range of barracks. The wars which immediately after ensued, probably in this, as in more conspicuous instances, led that capricious Nobleman to forget the arts o peace and utility. Though Sir Charles (now Lord) Metcalfe, formerly Governor General, and Sir Jaspar Nicolls, late Commander-in-chief in India, considered Ther-

mantidotes of much value, and used them in their own houses and tents from the time they were invented, these machines have not yet been turned to any public account in India. No steamers have hitherto been adapted, as they might and should be, to the comfort of passengers in hot latitudes. The East India Company's vessels between Bombay and Suez are all but intolerable to landsmen for want of a free and constant circulation of air. Neither have the magnificent ships of the Peninsular and Oriental Company, on the Calcutta and Suez line, any thorough draught, except in a few of the principal cabins. The consequence is, that being unable to sleep in the places intended for their luxurious accommodation, most of the gentlemen, and many of the ladies, are obliged to lie all night in the open air, like cattle on deck. This palpable defect admits of a very easy remedy. With the power of the engines at command, Thermantidotes could be made without difficulty to send artificial currents of air through every part of the steamers. Independently of alterations obviously required, and demanding little expense, a cool breeze directed through the passages as they now stand, would do much to render the cabins on each side inhabitable when the atmospheric heat is highest.

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ON THE ATMOSPHERIC AND MAGNETO-ATMOSPHERIC RAILWAY SYSTEMS—AND THE ADVANTAGES TO BE DERIVED FROM THE ADAPTATION TO THEM OF COLES'S ANTI-FRICTION CARRIAGES.

Sir,—That railway trains are much less liable to come into collision with each other upon atmospheric railroads than upon railroads of the ordinary description, (if they are not indeed entirely free from that danger,) is a fact, I believe, generally acknowledged; a matter of no trifling importance to such of her Majesty's subjects as have much occasion to travel. Now, then, that an improved method has been publicly promulgated for doing away with the longitudinal valve in atmospheric railways, and for connecting the piston, as it were, with its attendant train, by the simple aid of a powerful electro-magnet—a method which, if successfully reduced to practice, bids fair to render atmospheric railways far more general, and so to reduce the dangers attendant upon railway travelling, more perhaps than any other recent improvement—surely I may be excused for introducing to your notice, and to that of your numerous readers, any suggestions tending to facilitate so desirable an object. The magneto-atmospheric railway has formed the subject of at least one patent, as stated in your valuable Journal, but that the idea is not new to me, I may be perhaps freely allowed to own, as I do so without either the power or even the wish, in the smallest degree, to detract from the merits of any of the patentees, who certainly did not gain the notion from me, as I never communicated it to a single individual.

In my intention to bring the matter before the notice of the public, I have been most fully and completely anticipated: I have, however, thought much upon the subject, and still feel in the success of the undertaking an extreme interest, with, I hope, many others; for who indeed can feel callous to the numerous and appalling accidents arising from railroad collisions which unfortunately are of such frequent occurrence?

For my part, I seldom take up a newspaper without feeling a kind of misgiving, as to whether or not the words "Frightful Railway Accident" will not meet my eye in some one or other of its columns, in large letters: and were I connected with Life Assurance Companies, or had I the honour of being one of her Majesty's advisers, I should in all cases of great importance be decidedly inclined for stipulating—for no other mode of railway transit than the atmospheric.

But now, to the more immediate subject of my communication: That the projectors of the magneto-atmospheric railway will have several rather serious difficulties to contend with, may be reasonably expected; but I anticipate for them a most important triumph. Let them not neglect the means—let every possible facility be afforded them—let every possible chance of success be pressed into their service.

It was suggested many years ago, and afterwards most fully proved, that a horse upon an ordinary tramway or railroad, could draw at the very least, *ten times* the amount of tonnage he could move upon the ordinary turnpike way.

Now, a much neglected gentleman, but a man possessed, nevertheless, of no ordinary mind, a man who has climbed both to fame and to fortune in his own particular line of business by his ingenuity and persevering industry, not only

undertook to prove, but fully succeeded in proving, upon a small scale, that by the introduction of a simple arrangement, the addition, in fact, of a couple of anti-friction wheels to each of the wheels of the carriage or carriages, upon a rail or tramway, this advantage might be increased tenfold farther, *four* ounces being shown to do the work of *forty* ounces; I allude, of course, to Mr. Coles, of patent truss celebrity.

Mr. Coles was laughed and sneered at, at the time; but the fact still remains for all that, as he has not only proved over and over again, but, as I have distinctly been given to understand, he is at any time open to prove to any one who will take the trouble to witness the experiments.

Whether time is an essential ingredient to the perfecting and carrying out of all such plans, as at first appear bold and startling, however correct or really useful they may be; or whether Mr. Coles was unfortunate in his original mode of illustrating the subject, inasmuch, as like most other projectors, who are in general very sanguine, he proposed going too far or doing too much, and so failed in carrying the public mind along with him, I will not pretend to say: I am inclined to think both; for instead of being satisfied with less than half of the advantage already gained, which might well have contented any moderate person, he was for increasing the tractive power still farther up to forty-fold, which rendered the matter too complicated.

There is an old saying, Sir, that when anything is laid upon the shelf for seven years, it will come out again as good as new; and so I apprehend it to be with the matter in question.

Certain it is, that at the time Mr. Coles commenced his patent, atmospheric railways were quite in embryo. The heavy locomotive was *then* considered a matter of *necessity;* and Mr. Coles's intrinsically beautiful arrangements (for I have no hesitation in calling them so,) for the time fell to the ground.

Let us consider, however, the advantages to be derived from the use of Mr. Coles's anti-friction carriages in connection, first with atmospheric railways in general, and afterwards with the magneto-atmospheric railway in particular; and allowing for the possibility of the anti-friction carriages working much less advantageously when upon a large scale, or in the ascent of steep inclines, &c. we will assume the required amount of tractive power to be diminished, not tenfold, but four-fold only, or that 10 oz. will do the work of 40 oz.

First, the required tractive power being thus diminished, the atmospheric tube might be diminished proportionally, that is to say, the tube laid down might be one-half only of its present diameter; it could therefore be manufactured with far greater ease than at present—would be much stronger, though of far less weight—and could be laid down at far less expense than at present; a matter highly worthy the attention of civil engineers and of railway companies, and particularly at the present moment, when numerous schemes are, in point of fact, at a stand still, from the heaviness of the estimates.

Secondly, If the tubes laid down were but half their present diameter they would not contain so much atmospheric air, as at present; in fact, one-fourth only; consequently, about one-fourth only of the power now required would be found necessary to exhaust them; or suppose we were to employ, say, half the power now made use of, or something more, and to place the stationary engines at almost double their present distance, surely there would be great and important advantages.

Again, as regards the uses of the electro-magnet, it is needless perhaps to assert that, provided my first position be correct, which, as before observed, Mr. Coles has over and over again proved, and can undertake to prove in the presence of respectable witnesses, then an electro-magnet of one-tenth only, but let us say one-fourth only, of the power required under ordinary circumstances would of course suffice. Now, does it not strike the most common observer in such matters, that this is also an advantage not to be treated lightly—that in fact it may prove to be a great acquisition, if not the one thing needful, to the practical working of the Magneto-Atmospheric Railway?

I know it will be said that there are objections to the anti-friction carriages; that, in the first place, they are more expensive, and more liable to wear and tear; and that, *perhaps*, when travelling at high velocities they may be liable to get out of order, and on that account be

found to be inconsistent with increased public safety. But surely these are matters deserving a most searching enquiry.

I am inclined to the opinion that Mr. Coles's plan is not only correct in theory, but that as far as it has hitherto been applied, it has most completely borne out all that could be possibly anticipated from it; nor should I feel at all surprised if it should come out, upon thoroughly investigating the matter, that a carriage *properly constructed* upon this principle would last longer than any other, and upon that very ground, therefore, would *not* be more expensive—that the liability to get out of order is in fact more fanciful than real; since, where the wearing parts are, there is in the anti-friction carriages, on Coles's principle, scarcely any apparent motion—and that their capability for travelling with safety at high velocities follows as a matter of course, and in a very especial manner, from these premises. But even supposing that some slight modification of existing practices should be found necessary in the first laying down of the rails, &c., in order to ensure to a full extent the promise of such great and lasting advantages—surely even that difficulty ought not to be considered insuperable. The last great improvements, let us bear in mind, even in our *common roads*, did not take place until after the introduction of *springs*, against which introduction there was at first a great outcry, and from the ungrounded assumption, more particularly, of a want of safety.

Do you, Mr. Editor, give to this matter a little of that wholesome and nourishing attention you sometimes so advantageously bestow upon matters of really less moment; for let the matter but once obtain a fair hold upon the public attention, and we may see some great results even yet.

Do not pronounce hastily; for I have an impression that some rather severe, but hasty, and undeserved strictures found their way some years ago into your highly useful publication from your talented correspondent, Mr. Baddeley; to the pages of which publication, therefore, the gentleman alluded to, or at least his plans, have been hitherto by no means indebted for any great share of the public favour.

Mr. Coles's proposition at first appears so startling, that I cannot certainly feel surprised at Mr. Baddeley being a little guarded upon the subject, but I hope he is open to conviction: and surely it would have been more to the purpose if he had tested the matter by practical experiment before denouncing the principle so publicly.

Whilst I am upon this subject, allow me to ask a few queries of such of your correspondents as are well informed upon the subject of electro-magnetism, &c.

Query 1. During the common experiments, in which a needle is made to float in an earthenware basin half filled with water, and in which experiments the floating needle will, upon the application of an ordinary magnet to the outside of the basin, be seen to approach towards such magnet, and may be afterwards dragged along in the same path as the magnet, by slowly moving the latter around the outside of the basin, the needle being evidently under the influence of magnetic attraction, notwithstanding the existence of the intervening vessel: Is there, or is there not, a direct communication kept up and required to be kept up, by the passage of the magnetic fluid from the magnet to the needle, either through the pores of the earthen vessel, or else over the edge of the basin—and which is it?

Query 2. Assuming such communication to exist and take place, *not* through the pores of the vessel, but over the edge of the basin, would not a similar effect be required to be produced, and also to be kept up, upon the Magneto-Atmospheric Railway—that is to say, would it not be required that a direct communication should exist between the electro-magnet and the propelling piston, by the passage of the magnetic fluid from the former to the latter, at *starting;* and would not such direct communication have to be kept up between them during the whole of the journey to be made, so that the magnetic fluid, in other words, would have to travel at precisely *double* the rate of the train of carriages? A matter of no moment in itself, inasmuch as the fluid is known to be capable of travelling at such amazing velocity.

Query 3. Would it not necessarily follow, should the last position be correct, that upon the electro-magnet being thrown into disuse, either accidentally, or by purposely disconnecting it with the battery, say in the middle of a journey,

there would be at least a difficulty if not an impossibility of again resuming at pleasure the magnetic hold upon the piston, without again bringing up both magnet and piston to the starting point.

I am aware that there is a difficulty in solving this problem by experiments upon a small scale, and although I, for some reasons, have still my doubts upon the subject, I by no means wish to convey it as my opinion that such difficulty exists, still less that it is insurmountable; on the contrary, I recollect several years ago, when at the Enrolment-office, reading the specification of an improved registering barometer, in which the registering was performed by the use of a small magnet made to float in a vacuum upon the top of the mercury, and which magnet was said to act upon a pencil placed within an iron pencil-case outside the tube.

I never by any accident happened to learn how far the invention was found to answer in practice, but if well, it would argue that the passage of the magnetic fluid—if, indeed, any communication between the magnet and the iron pencil-case was kept up or existed at all—might have taken place through the pores of the glass tube; and yet this does not necessarily follow, since the distance was but trifling, and as the magnetic fluid is known to play in a vacuum, it might have been given off from the glass tube at its terminating point.

Claiming your kind indulgence for this long letter,

I remain, Sir, your obdt. servant,

G. H. BURSILL.

London, Feb. 9, 1846.

## LONDON INVENTORS AND MECHANICS' SOCIETY.

A society is in the course of formation under the above title, which has for its object to assis tinventors with the advance of the pecuniary means requisite for securing their inventions by patent or registration. The projector and secretary is Mr. Vincent Price, of 33, Wardour Street, who is himself the author of a very clever (but unprotected) bonnet-pressing machine, described in our 40th volume, p. 184; and the committee of management consists wholly of individuals of the class of tradesmen. A public meeting of persons friendly to the objects of the society was held last week at the Western Literary and Scientific Institution, Leicester Square, and was very numerously attended. We extract the following account of the proceedings from the *Sentinel*, a weekly newspaper distinguished for its attention to the affairs and interests of the industrious classes.

Mr. T. S. Duncombe, M.P., took the chair amidst great acclamation.

The honourable member in explaining the object of the proposed society, stated that its design was to put patents within the power of the workman, instead of leaving his inventions and himself at the mercy of wealthy capitalists, who only, at the present day, could avail themselves of the patent laws, on account of the heavy expenses attendant on procuring them. Such a society was indeed greatly required to protect the ingenious, who were unable to afford the requisite expenditure. He was pleased with the project, and would further it to the utmost extent of his abilities. He was especially induced to do so, when he found that the parties originating it were persons who had themselves been working men, but who, having succeeded in elevating themselves to the rank of masters, each employing a number of persons, instead of following the example of too many, by kicking down the ladder by which they had ascended, now stood forward to give a helping hand to those who were toiling below them. As several of them were also patentees, the purity of their motives was beyond a doubt. He had only one objection, and that was to the title. He would wish that the association bore the name of National Society, instead of London Society; for why should not the ingenious mechanic of any part of the country, or even abroad, be allowed to participate in its benefits? The hon. member then called on Mr. Price, to whom belonged the honour of first suggesting the society, to move the first resolution, expressive of the injury resulting from the patent laws.

Mr. Price said that he had been long impressed with a conviction that something more was required to be done to develope the ability of the mechanic. At present he had no means of securing that benefit from his inventions to which he was fairly entitled. The present society was intended not merely to protect him in obtaining the patent, but also to afford him the means of working out his ideas. All this was proposed to be effected by small contributions from each member.

Mr. Horry, (barrister,) seconded the motion, and observed that at the present moment there was not a single institution to enable a working man to effect the grand object now in view, that of putting him in a situation to command the capitalist—he might say there was not a society to encourage the inventive genius of the really operative classes. The Society of Arts laid claim to the distinction of being especially formed to assist by rewarding the industrious and ingenious artizan, but, in point of fact, the pretensions of this society formed a series of as complete fallacies as ever excited the agony of disappointment. At its origin, after the cessation of the troubles which commenced with the Revolution, and continued to the rebellion, it was certainly successful, in a measure, in arousing the torpid genius which had been lost amongst them. Every farthing of their income, often not exceeding £300, was spent in the legitimate objects of its establishment. Nollekens was brought forward by the reward of £50, bestowed for a small piece of sculpture, and was thus enabled to push his way onwards. Other artizans had likewise profited in the same manner. For many years past, however, the reverse system had been pursued. With an income, at the very lowest estimate, of £1000 a-year, the annual amount expended in rewards averaged about £40, the nature of the rewards being completely dispro-

portionate to the subjects on account of which they were bestowed. As an example of his statement the learned gentleman alluded to two rewards given during the session of 1845, one being a large gold medal for the importation of wine from Australia, while a weaver was considered fully remunerated with a silver medal and five pounds for an apparatus enabling a one-armed person to use a knife and fork. He also mentioned two cases where the individuals had been obliged to pawn the medals, to obtain subsistence for their families, after expending time and money in modelling the inventions for which they were rewarded. Besides, the Society of Arts required the abandonment of an invention or improvement to the world as a condition precedent to the reward, the result of which regulation had been ascertained to be that foreigners had patented these very inventions in their own country. And this was what the society in their circulars termed acting with liberality! The advantages of the present over that society was thus clearly manifested. Mr. Horry then alluded to a difficulty which had been interposed by the registrar of the Joint Stock Companies Act, who was inclined to view the society as subject to his rules, while a recent decision had prevented Mr. Tidd Pratt from enrolling it under the Benefit Societies Acts. The result was that a bill had been introduced by the hon. member in the chair to obviate such difficulties. It had been originally designed to declare the society established that very night; but, under the circumstances explained, it had been thought better to defer its final formation to an early day.

Mr. Dalrymple moved the second resolution, declaring the opinion of the meeting that the society was exceedingly desirable, and would be productive of great benefit. Mr. Smith seconded the same.

Several other speakers addressed the meeting, among whom was Monsieur Gouché, a French artificer, who explained the superiority of the patent laws in France.

A committee was then unanimously appointed to carry out the objects of the meeting.

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The objects of this society are so indisputably laudable, and promoted in so fair, discreet, and business-like a spirit, that we cannot do otherwise than most cordially wish it every success. The legal difficulties in the way of dealing with patent property are at present so considerable—the number of persons who can have a proprietary interest in a patent being limited by law to twelve—that, were things to remain as they are, we should have but slender hope of the society's effecting much good; but if, by such a change in the law as Mr. Duncombe is stated to be promoting, associated bodies of the working classes can be enabled to hold patent, like house or any other description of property, the way to a vast degree of usefulness will be clear and certain. Mr. Duncombe thinks the present association should have been called "the National" rather than "the London" Society. We do not share in this opinion. No one society could meet that universal want which has given rise to the present movement. The merits of inventions are, besides, likely to be best understood and appreciated in the localities where they originate. An improvement in cotton-spinning, for example, would, to a certainty, be more promptly recognized in Manchester than in London; or a new lock might be picked in an instant at Wolverhampton, which would long defy all the locksmith skill of Norwich or Cambridge. We should like, in short, to see such associations established in every large town, and see no reason why Invention Societies should not be as numerous and profitable as Building Societies.

We are not blind or indifferent to the great grievance, which is at the bottom of this endeavour of the industrious classes to obtain better protection for their inventive and productive talents, namely, the enormous and oppressive expense of patents. But even though this egregious defect in our political system were rectified, as it will doubtless be ere long, there would still be ample room for the friendly aid of such associations as the present, to enable inventors to bring their wares to market. The best proof that can be given of this is, that in the United states where patents are cheap (25 dollars only) an Association of Inventors, having much the same object as this of London, has been recently established at New York. We shall give some account of this transatlantic society in a future number.

Our London Society will hold another meeting, to report progress, on Wednesday next, at the National-hall, Holborn.

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## PARSEY'S COMPRESSED AIR-ENGINE.*

Sir,—The following remarks on Mr. Parsey's "Compressed Air Engine" were suggested by a visit made a few days since to the working model in Pall Mall, and are communicated with the view of calling attention to a radical defect in the principle of its action, which, from the high praise and patronage that have been bestowed upon the invention, appears to have been overlooked. This has rather surprised me, from the fact that it is a defect of great magnitude, and depends upon the evident operation

* We stated in our last our intention of offering some observations of our own on this subject. But it is so well treated in the letters from our correspondents which we now publish, that we willingly leave it in their hands.—Ed. M. M.

of the simplest elementary principles of pneumatics, upon which the supposed efficiency of the engine is founded.

The object of the patentee is to obtain, by means of compressed air, a portable reservoir of power, and thereby save the wear and tear of locomotive steam engines, as well as the difference of expense incurred by using one large stationary engine instead of several smaller locomotives, in order to obtain a given amount of power.

He states in the prospectus that, "it is generally admitted that the least expensive, as well as most effective means of motive power, is to be found in the use of air; but the means hitherto have been undiscovered of *regulating* and applying the power of *condensed* air, so as to make it available in all great commercial undertakings which are conducted through the agency of steam power;" and that, "by the present patent, condensed air is applied in the most simple manner, so as to obtain an uniformly regulated motive power, perfectly controllable, and capable of being instantly increased or decreased at pleasure."

The locomotive engine is described as consisting "of a pair of cylinders and pistons acting on the cranks of the driving wheels in the usual manner. Before and behind these are two reservoirs of compressed air, between which is a vessel called a receiver, and immediately in contact with it is a nicely-regulated valve in the pipe, which conducts the high-pressure air into the receiver. Attached to the rod of this small piston is a spiral spring, coiled round it and acted upon by a screw outside, in such a manner that the person in charge of the engine, whatever the amount of pressure in the reservoir may be, can regulate and direct the force to any degree. The air-engine is very simple in its structure, and very similar to the present locomotive, and may be constructed for about half the expense."

This description, however, does not convey a sufficiently clear idea of the mode of action of the essential feature of the invention, viz., the receiver and its self-acting regulator.

It is proposed that at each station there shall be kept, ready charged, a large reservoir of compressed air, from which the portable or locomotive reservoirs just described shall be supplied, and that these are to be charged to a pressure far exceeding that of the working pressure to be obtained by the action of the regulator. The patentee proposes that the reservoirs shall be made strong enough to resist a pressure of from 1,000 to 2,000 lbs. per square inch, and that the working pressure shall be about 60 lbs. to the square inch.

The condensed air is admitted from the reservoirs into the receiver or equalizing chamber under the plug of the regulating piston; and as soon as it acquires the working pressure to which the spring (which re-acts against this piston) is loaded, it forces up the piston, and thereby throttles the valve, which shuts the communication between the receiver and the reservoir.

From this receiver the compressed air is now admitted to the working cylinders in exactly the same manner as the steam of a high-pressure steam-engine.

It will now be easy to show, from the principle on which the regulator acts, that there must be a loss of power, varying directly with the difference between the elastic force of the compressed air in the reservoir and that adopted as the working pressure.

Let us now suppose, for example, that the compressed air in the great reservoir at the station is condensed to 16 atmospheres, or a total pressure of 240 lbs. to the square inch, and that the regulating spring is loaded to 45 lbs. per square inch. The total elastic force of the air, when admitted into the equalizing chamber will, therefore, be equal to 45 plus 15, or 60 lbs. on the square inch, and its density four times that of the atmosphere,* or one-fourth of that in the reservoir.

If we further suppose that the chamber has a capacity equal to four cubic feet, then one cubic foot of the condensed air from the reservoir will be required to fill it; and this cubic foot of air will have its total elastic force reduced from 240 lbs. to 60 lbs. on the square inch.

It may perhaps appear, at first sight, that there is no loss of power here; for, as the elastic force is diminished one-fourth, so must the whole volume be

* I here assume the correctness of the Boylean law, that the temperature remaining the same, the density of the air varies exactly with the compressing force. This, however, has been found to differ from the truth by a small fraction—too small to affect practical considerations.

increased four times, and therefore the power is the same, since it will be exercised through four times the space.

If we were working in a vacuum this would be exactly the case, but as we have always the resistance of the atmosphere to overcome, it is evident that in proportion as we increase the surface bounding a given amount of compressed air, so do we increase the pressure against which it is necessary to react; or in other words, as we increase the space through which it acts, so we increase the quantity of atmospheric pressure it has to contend against, or, as it were, lift up.

Thus in the instance quoted, the cubic foot from the reservoir exerts an available force of $240-15=225$ lbs., and when expanded each cubic foot gives us $60-15=45$ lbs. available force; but then we have four times the quantity to work with, or $45+4=180$ lbs. available force after the expansion in the equalizing chamber, and thus there is a loss of power of $225-180=45$ lbs. raised one inch for every cubic inch of compressed air in the reservoir.

A little reflection on the *rationale* of the above will point out the following as the formula for expressing the amount of power lost when the degree of compression in the reservoir and the working pressure indicated by the regulator are given:—

Let F represent the total elastic force in the reservoir, and $f$ that in the equalizing chamber, then the loss of power will be equal to $\frac{15\ F}{f}-15$, that is fifteen times these forces, minus fifteen.

We see by this, that in proportion as we increase the disproportion between the compression of the air in the reservoirs and that which works the engine, so do we increase the loss of power; and therefore, the only possible case in which this system might be advantageously applied, would be for running a train by very short stages, certainly not exceeding one or two miles at the utmost. The idea of working it by stages of fifty miles, as the inventor proposes, is a wild absurdity; for in order to do this, the size of the locomotive reservoirs must be enormously great, or the condensation of the air within them such as to render the available power only a small fraction of that required for its condensation.

From these considerations it is at once evident that no practical conclusions whatever can be drawn from working models, and that, in fact, nothing can be more fallacious than the mode of testing it.

Everybody is aware that a little carriage or train may be made to run along a short road by winding up a steel spring in connection with an arrangement of ratchet wheels; but no sane man would attempt to apply such a system to practical locomotion, though for *very* short stages it *might possibly* be used. Now this case is exactly analogous to the compressed air-engine; in one instance we use the elasticity of a gaseous, and in the other that of a metallic body, the same defect belonging to both, viz., that they are self-exhausting and varying forces acting only through a limited range; and though it may be urged in favour of the atmospheric medium, that its range is wider than the metallic, still the old-fashioned toy has the countervailing advantage of being capable of regulation without further loss of power than that dependant on friction.

Yours respectfully,
WILLIAM WILLIAMS.

1, Francis Street, Regent Square,
March 9, 1846.

P.S. The whole of the above, with the exception of the few concluding lines, was written early in last week, previous, of course, to my seeing your last Number, where reference is made to the subject. Nevertheless, I now send it, as you may, perhaps, deem it worthy of insertion on account of the extreme popularity of this "bag of wind" speculation, owing to the skilful manner in which it has been puffed.

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Sir,—As you have hitherto taken the lead in denouncing the mechanical schemes of the bubble class, I think you might do the public some service by noticing the "Compressed Atmospheric Air-engine Company." Apparently, there is a large amount of capital in the course of being diverted into this speculation, but without, in my opinion, the slightest chance of success.

It must surely be evident to any one, however ignorant he may be of engineering, that if power be expended in condensing air to 1000 lbs. per square inch, and it is then moderated to 50 lbs. per

square inch before acting upon the piston, there must be a certain amount of power lost. What this loss of power is, may be easily made a matter of practical experiment, but may be also arrived at by a reference to the known laws of the compression of aeriform fluids.

Let us proceed upon the supposition that "the mean power required to compress air is equal to the mean power given out by steam when worked expansively, the pressure being the same." Now, by the use of hyperbolic logarithms, I find that a mean power of 78lbs. (nearly) per square inch is required to work a force-pump compressing air to this density. Well, 1000 inches so compressed, will occupy 15 inches in the receiver, but when admitted to the regulating cylinder, they will occupy a space of 300 inches, with a power of 50 lbs. per square inch. The amount of power lost, becomes, therefore, a Rule of Three statement:—

lbs. in. lbs. in. lbs. lbs.
$78 \times 1000 : 50 \times 300 :: 1000 : 192$

nearly. That is, every 1000 lbs. power expended gives only 192 lbs. of useful effect!

If the pressure of the receivers be increased the loss will be still greater. At 1500 lbs. per square inch it would require a mean power of 84 lbs. per square inch of the piston to compress air to this density; 1000 inches would occupy 10 inches in the receiver, and 300 in the regulating-cylinder with a power of 50lbs. per square inch. The weight would, therefore, stand thus:—

lbs. in. lbs. in. lbs. lbs.
$84 \times 1000 : 50 \times 300 :: 1000 : 178\frac{1}{2}$

nearly. In this I have not included the loss from leakage, the increased friction of a land-engine pump and locomotive, as compared with the present locomotive. The total loss may be safely estimated at 90 *per cent.*

The bulk of the air-vessel attending the locomotive must likewise be twenty times the cubical contents of the present water tank.

I cannot help adding farther that 1000 lbs. per square inch is a dangerous pressure to be so employed. The projectors assert that air possesses all the expansive power of steam; this is quite true, but it is also true that it is equally dangerous.

Yours very obediently,
A. W.

### HOW TO INCREASE THE GRIP OF RAILWAY WHEELS IN WET WEATHER.

Sir,—Allow me through the medium of your valuable journal to call the attention of Railway Directors to a simple contrivance for preventing a class of accidents which frequently occur, owing to the detention of trains in wet weather, caused by the slippery state of the rails. My plan is simply this: Let there be a square hollow tube, made of iron, four inches by two inches, about a foot and a half high, placed perpendicularly over the driving wheels, which could be attached to the guard over the wheels, the tubes to have a moveable cover on the top, and open at the bottom shaped out to the circle of the wheels, the tube to be fixed to come close to the wheels, but not to touch them. Put into these tubes blocks of chalk, shaped to the tubes, to fit quite easy, to allow the chalk to rest on the wheels by its own weight; but if this were found not sufficient, a weight could be placed on the top of the chalk, to press it down more. By this means, the wheels would be kept constantly chalked, which would cause them to bite the rails quite as firmly as in dry weather; thus preventing any decrease of speed, to the danger of the passengers, &c. This simple plan, which from the well-known property of chalk in increasing friction in various ways, I have no doubt would be found to answer, would be a very trifling expense to the railway companies, and lessen the dangers of this (in some respects) fearful mode of travelling. The engineers could at all times have a supply of these blocks of chalk, to use when required, which might also be found very useful in ascending inclined planes even in dry weather. Hoping you may deem the above suggestion worthy a place in your columns, I am, Sir, your obedient servant,

J. D. Dewick.

March 5, 1846.

### THE "JANUS" STEAM SHIP—THE EARL OF DUNDONALD IN FURTHER EXPLANATION.

To the Editor of *The Times*.

"The Admiralty are deliberating whether they will allow any further attempts to make the *Janus* succeed to occupy the valuable time of the dock-yard hands, and cause a fruitless expenditure of public money."—*The Times*, March 5.*

Sir,—Whilst your journal is open to

* We subjoin the entire paragraph from which the above is extracted.

"The *Janus* went out of Portsmouth harbour on Friday last, at a quarter before 7, a.m., and proceeded

the promulgation of truth, misstatements cannot long prove injurious to the public service.

On the 7th of November you had the liberality to insert an account of the obstructions which during 18 months delayed the working of the Portsmouth revolving engine, and for five years and a half defeated the trial of its power by pumping water. On the 10th of January you gave to the world a testimonial of its efficient performance, which appearances continue to show will be much longer merited.

The impediments hitherto presented to the full manifestation of the power of the *Janus's* engines have been more difficult to detect than the plugs and stops found in the pipes and pumps of the Portsmouth engine. Until more certain information can be obtained whether air leaks and other mischiefs, fatal to condensing engines, were the result of accident alone, I offer, with a view to benefit the interests of the naval service, a few observations showing how even a laudable intention of the Admiralty to ascertain an important object can be frustrated.

Had I the means I could practically prove in a very brief time that the boilers, the engines, and the lines of the *Janus* are founded on sound principles; but can individuals succeed against opposing causes, which arrest the Admiralty itself, unless supported by public opinion?

Sir, prolonged cruises and lengthened voyages are objects quite invaluable, but even the mere prospective saving annually to be derived, as proved in the accompanying paper, cannot fail to be ten times greater than the much-reprobated cost of the machinery of the *Janus*.

The public, perhaps, may not be aware that Her Majesty's steam-ships consume from 16 to 60 tons of coal per day, which on some foreign stations cost twice as many pounds.

I am, Sir, your obedient servant,

DUNDONALD.

London, March 6.

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*Remarks on the Official Reports respecting the comparative evaporation of the boiler of Her Majesty's steam sloop "Janus."* 1844.

Tubular boilers for the naval service are, to some extent manufactured at Woolwich Dockyard, under the superintendence of the chief engineer and inspector of machinery. The boilers destined for the *Janus* were constructed elsewhere, on another principle, with a view to economy of fuel.

In order to ascertain the comparative merits of these boilers, application was made to the Lords Commissioners of the Admiralty to direct their evaporative powers to be tested. The results of the daily trials were recorded in documents bearing date the 19th and 29th of November, attested by the signature of the chief engineer.

The Woolwich boiler, fired "in the manner in actual use at sea," designated by the chief engineer (in his report of the 18th of December, 1844) "the most practically useful," evaporated 8·833 pounds weight of water per hour, by each pound of coal consumed; as appears by the average of the trials of the 8th and 9th of October.

The boilers of the *Janus*, fired under the same superintendence, but according to specific regulations (sanctioned by the Admiralty on the 26th of October,) produced an average evaporation of 12·692 pounds of water by each pound of coal; as appears by the trials of the 5th and 6th of November.

The effect of the Woolwich boiler, fired in the manner termed the most practically useful, was 40 per cent, less than that of the *Janus's* boilers; each boiler being new, clean, and in good order.

An inferiority so marked induced the chief engineer to institute rival trials, and to make great alterations in the Woolwich boiler, whereby the relative proportions of the fire surface, the evaporating surface, and fuel, were assimilated to the successful proportions of the *Janus's* boilers.

On the 15th, 16th, and 19th of November, the alterations made in the Woolwich boiler amounted to 34, 68, and 52 per cent. on the furnaces, surface, and amount of fuel, which alterations improved its effect full 20 per cent. Further alterations took place on the 21st of November; the fire surface was lessened to one-half, the evaporating surface was thereby relatively doubled, the average

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round the Isle of Wight, by way of St. Helen's, and returned into harbour at 7, p.m. On this trip she made from 12 to 20 revolutions per minute; her speed consequently is various, uncertain, and unaccountable. She will not go against tide or a fresh wind; a little sail has an extraordinary effect upon her—under steam and sail she went nine knots. The *Rattler* did not leave the harbour on the same day until 20 minutes before 12, but came up with the *Janus* near the Needles! The Admiralty are deliberating whether they will allow any further attempts to make the *Janus* succeed, to occupy the valuable time of the dock-yard hands, and cause a fruitless expenditure of the public money."—*Times*, March 5.

hourly consumption of fuel was reduced from 758 lbs. to 270 lbs. weight, and the coal consumed on each superficial foot of fire-bar surface was varied from 17·11 lbs. to 7·58 lbs., as is proved by the recorded trials of the 8th and 9th of October, and those of the 21st, 25th, and 26th of November.

Referring again to the documents of the 19th and 29th of November, 1844, in which these daily trials are recorded, with their results, attested by the signature of the chief engineer, it appears incredible that (on the 8th of February following) the chief engineer, in reference to trials so recorded, did officially report to the Admiralty that "in order to make the trials between the boilers as correct as possible, the coals were hand-picked, (but) no other alteration was made in the mode of firing"!

By this extraordinary assertion not only the cause of the improved evaporation of the Woolwich boiler, but the fact of alterations having been made therein is concealed, and their lordships are left to infer that the increased effect is produced by hand-picked coals—a fortuitous circumstance, destitute of merit, resorted to during the trials of the *Janus's* boilers, merely to select Welsh coal (similar to that with which the Woolwich boiler had been tried on the 8th and 9th of October,) because comparative evaporation could not be accurately ascertained by using a mixture of various kinds of coal, as thrown together in store at Chatham. However, as hand-picked coals were not used in the Woolwich boiler on the 15th, 16th, and 19th of November, when the economy of 20 per cent. was obtained, such economy was manifestly produced by the alterations or imitations so withheld from the knowledge of the Admiralty.

In further refutation of the assertion that no alteration was made in the mode of firing, save by hand-picked coal, it may be added that, on the 9th of October, before the coal was hand-picked, the Woolwich boiler evaporated 110 cubic feet of water per hour; which amount, when hand-picked coal was resorted to on the 21st of November, diminished to 77 cubic feet; then, on the 25th, declined to 70 cubic feet; and on the 26th of November, the water evaporated was only 55 cubic feet,—thus incontestably proving that the economical effect (accompanied by diminished evaporation) was due to the concealed imitations, and not to the improved quantity of fuel, which would have augmented, instead of lowering, the amount evaporated.

When the boilers were preparing for trial, the average consumption of fuel in the steam department of the naval service (as stated in writing by the chief-engineer on the 10th of August, 1844,) was, "under favourable circumstances, 8lbs. per horse power per hour; and when the coals are bad, or the engines and boilers out of order, it comes up to 10lbs. or 12lbs." From this estimate the Admiralty were informed that a saving of one-third might be effected, which anticipation is fully justified by the recorded trials, proving that the consumption of fuel in the *Janus's* boilers was only 5lbs. per cubic foot of water evaporated, whilst in the previous trials of the Woolwich boiler the consumption was 7lbs., or 40 per cent. greater; and when both boilers were distinguished by their greatest economy (the coal being hand-picked, and in the latter all alterations and imitations practised,) the evaporation of the *Janus's* boilers was 40 per cent. greater in amount than the Woolwich boiler; the respective evaporating surfaces being 1,057 and 1,073 superficial feet, and the hourly evaporation 55 and 78½ cubic feet of water.

Numerous important duties prevent the Admiralty from investigating disputed questions; therefore the assertions contained in the reports of the chief-engineer (dated the 9th and 18th of December 1844, and 8th of February 1845,) escape being contrasted by their lordships with facts on which they profess to be founded (as on the records of the trials bearing date the 19th and 29th of November.)

Thus the official adoption of a principle, and of proportions, which would render boilers in the naval service equal to the far-famed Cornish boilers in economy, seems indefinitely postponed; for the chief-engineer intimates, that "the experience of a few years, by making boilers of the ordinary construction," may enable him to determine their proportions!

Lapse of time, perhaps, might render improvements (successfully concealed) apparently his own; but to avoid the dilemma of admitting a want of knowledge on a professional subject, or to incur the responsibility of having officially passed and received for the naval service, as inspector of machinery, boilers of defective proportions, requiring to be urged by fierce and destructive firing to perform their duty, assuredly seemed to the chief-engineer and inspector of machinery a course "practically useful" and pressingly important.

DUNDONALD.

London, March 5, 1846.

[The preceding explanations throw more light on the failure of the *Janus* than Lord Dundonald seems willing to acknowledge. Since her boilers are so superior in point of

evaporative power, it follows of necessity that it must be the engines which are to blame for her unsatisfactory performances. And the fault in the engines must of equal necessity be the result of one of two things —either the fallacy of the rotary principle on which they are built, or some defect in their construction—as, for example, a want of due proportion between the working capacity of the cylinders and the evaporative power of the boilers. It is very desirable that the whole truth of the matter should be brought to light.—ED. M. M.]

## NEW SERIES OF PROFESSOR SILLIMAN'S JOURNAL.*

We welcome with great pleasure a new series of this valuable Journal, and sincerely hope it may have greater success than the original one, which is understood to have been far from remunerative or encouraging. We must confess, however, that we should augur better of it, were it less like the old series—that is to say, less geological, less entomological, less meteorological, less fundamental and transcendental—were it, in short, more of a practical, every-day, useful, and generally interesting character. The "Scientific Intelligence" which occupies nearly one-half of the present number is incalculably the better portion of it, and contains a great many most instructive and valuable notices. We select by way of specimen the following:—

*New Metals.*—There have been three new metals lately discovered,—*Pelopium*, *Niobium*, and *Ruthenium*; the first two were procured from the Bavarian Tantalite by Prof. H. Rose, and the latter was found associated with the ore of platinum by Prof. Claus. Pelopium and Niobium exist in the mineral under the form of Pelopic and Niobic acids. (*Comptes Rend.*, Dec. 1844.) They resemble the tantalic or columbic acid so closely in all their properties, that it becomes difficult to separate them from each other. Prof. Rose has, however, obtained the Niobic acid perfectly pure, and the greatest difference between it and columbic acid appears to be, that it forms, when heated with charcoal and chlorine, a chloride that is colourless, infusible, and very slightly volatile, whereas the tantalic acid affords a chloride yellow, very fusible and volatile.

The Niobium is readily obtained in its metallic state, by submitting the chloride to the action of dry ammonia, and applying heat, when the metal is reduced with the disengagement of the hydrochlorate of ammonia.

The Ruthenium discovered by Prof. Claus, (*Chem. Gazet.*, Feb. 1845,) as already stated, is associated with native platinum, and is procured from what is called the platinum residue, (the residue after treating the platinum ore with nitromuriatic acid.) It is first fused with nitre at a red heat for about thirty minutes, and the fused mass treated with water and dilute acids, which extract the osmium and irridium; the solid matter left is now fused with its own weight of nitre, and kept at a white heat for two hours: the mass is taken out, while still red hot, with an iron spatula, and after cooling, reduced to a coarse powder, which is extracted with distilled water; so soon as the water becomes clear, it is decanted. It contains ruthenisate, chromate and silicate of potash. Nitric acid is added cautiously, until the alkaline re-action has disappeared; by this means, oxide of Ruthenium and potash, and some silicic acid, are precipitated, as a velvet black powder; after washing this powder, it is dissolved in muriatic acid, evaporated until the silica separates as a gelatinous mass; it is then diluted with water, and filtered. It must not be evaporated to dryness for the more complete separation of the silica, because the chloride of Ruthenium is thereby decomposed into an insoluble protochloride. The filtered solution, which is of a beautiful orange yellow colour, is evaporated down to a very small volume, and mixed with a concentrated solution of chloride of potassium, when the salt $KCl + RuCl^2$ separates in reddish brown crystals. J. L. S.

*Iridescent Silver.*—(In a note from Professor John Brocklesby, of Trinity College, Hartford, Conn., to B. Silliman, jun.)—It is well known to those who are conversant with optical phenomena, that the brilliant play of prismatic colours exhibited by mother-of-pearl is due to the structure of the surface; provided the shell is cut and polished in a particular manner. This interesting fact was announced to the scientific world in 1829 by the discoverer, Dr. Brewster, who successfully transferred by pressure the splendid tints of the pearl to black wax, fusible metal, balsam of tolu, lead, tin, and various other substances. The colours displayed by fusible metal possesses at first extraordinary beauty, which in a short time is partially lost,

* The American Journal of Science and Arts, conducted by Professor Silliman, B. Silliman, jun., and James D. Dana—Second Series. No. I. January 7, 1846.
Wiley and Putnam, New York, and London.

owing to a change that occurs upon the surface of the metal.

A few months ago, while engaged upon some experiments in electrotyping, I was led to think that by this process the hues of the pearl might be readily transferred to those metals, which from their hardness are incapable of receiving impressions in mass; but yet, on account of their freedom from oxidation, retain for a long time a surface comparatively pure. I therefore took a Smee's battery, which I had just constructed, and after several experiments succeeded in obtaining small sheets of silver, radiant with the hues of the shell. When seen by a single light, as that of a lamp, the play of colours is surpassingly beautiful, scarcely inferior to that of the pearl; and where equal care was employed, the plate of silver, which was formed eight months ago, rivals in brilliancy that which came fresh from the battery a few hours since.

The process by which this result is obtained is as follows. The first thing required is to prepare the shell. This is effected by grinding, and polishing it upon the back, in such a manner as to cut through the numerous concentric strata that compose its substance. When this is done, by the aid of a microscope the surface will be seen covered with delicate grooves, some thousand in an inch, formed by the sections of the concentric lamimæ; and this configuration gives rise to the glowing tints of the shell. The next step is to obtain an exact impression of this surface upon some good conductor of electricity. This we are enabled to do by means of fusible metal, if proper precautions are employed in taking the impression. I pursue exactly the same method as in taking the copy of a medal. After fusing the metal, I pour it upon oiled paper, and when the air bubbles cease to rise through the metal the oxide is skimmed from its surface with a card, and as soon as it presents the appearance of a perfect mirror the shell is forced down upon it by a sudden pressure. When the metal has cooled I remove it from the shell, and having ascertained the accuracy of the impression, immediately plunge it, before any change of the surface can occur, into the silver solution, thereby completing the circuit between the poles of the battery. In a few moments the surface of the metal is frosted with silver, and the configuration of the shell exactly copied. A sheet of silver, of sufficient thickness to be easily removed with a pen-knife, will be deposited in the course of five or six hours under favorable circumstances. The battery I have employed consists of two plates of amalgamated zink and one of platinized silver, 6 inches by 8. The working mixture is sulphuric acid and water, the strength varying with the temperature, and the amount of work to be performed. I have found a wine-glass of acid to three quarts of well-water, at the temperature acquired by standing a few hours in a room at 70° Fah., to answer very well, when the surface to be plated did not exceed 1½ square inches. The silver solution is made by dissolving cyanide of potassium in water, and adding thereto the oxide of silver. The ratio of the ingredients I am unable to state, as I have not hitherto directed my attention to this point, but have prepared the solution by trial until I obtained the desired result.

By the process above described, we can at pleasure transfer the tints of the pearl to those pure metals which will best preserve their brilliancy, and while the knowledge of this fact is interesting as a matter of science, it may perhaps be well for the artist to consider if it cannot be applied to some ornamental purpose, and the beauty of the precious metals enhanced, by teaching them to glow with the richest hues of light.

*Transparency of Quicksilver*, (*L'Institut*, No. 601, p. 279.)—M. Melsens has found that quicksilver in minute globules is transparent and transmits a blue light, slightly tinged with violet. These globules are formed when a fine stream of water is dropped on a mercury bath; the drops of water, in consequence of falling with some force, become covered with a thin pellicle of mercury, which present the fact here stated. The result has been verified by Arago.

*Mexican Fossils*, (cited from *Ann. Mag. Nat. Hist.* xvi., 1845, p. 212.)—In a letter to Professor Bronn, M. Claussen states that he has again found in Brazil a great many fossil bones, and among them the head of a large tiger related to *Felis meganthereon* (*Ursus cultridens*,) but it is much larger; the upper canine teeth are nearly ten inches long and 1½ broad. The French Institute has purchased it for 4,000 francs. The remainder of the collection, except the duplicates, has been disposed of to the British Museum. He promises subsequently to communicate some remarks on the occurrence of these fossil bones, and especially on that of the human remains, which are found among the bones of various extinct animals. He has discovered two kinds of *monkeys*, which approximate to the genera *Mycetes* and *Cebus*. A short time since also, among a number of pieces of amber (not copal,) he found some containing insects, in which distinct spiders' webs could be seen (thus fossil spiders' webs!!;) in some, the webs and also the insects hanging in them were evident.

*Infusoria.* — Ehrenberg has arrived at some remarkable results with regard to the prevalence of infusoria in volcanic rocks. They are as follows:—

Numerous and widely extended observations have proved that there is an ultimate reciprocal relation between independent infusorial life and the volcanic phenomena exhibited upon the banks of the Rhine. Volcanic crystals of sodalite, leucite, and probably of augite, consist in parts of masses of infusoria.

Although observation shows that in all parts of the world the infusoria, prevalent in volcanic rocks, are of *fresh-water* origin, still Patagonia affords *marine* deposits, constituting masses of great thickness.

The Pyrobiolitic rocks in Patagonia constitute extensive beds 800 feet thick, containing no carbonate of lime, and only here and there a little sulphate of lime.

The cinders which have been ejected by Pompeii, are of fresh-water formation; and they are similar to those constituting the tufa of Hochsimmer, on the Rhine.

The bed containing the fossil Mastodon, on the La Plata, and that of the fossil bones at Monte Hermosa, and the hills in the plains of Bahia Blanca, are formations of fresh-water origin, mixed with some marine.

## WOODCROFT'S SCREW PATENT.

*Judicial Committee of the Privy Council,*
11th March, 1846.

The Judicial Committee of the Privy Council met this day to consider of an application made by Mr. Benjamin Woodcroft for an extension of his patent for the screw with the encreasing pitch, (see *Mech. Mag.*, vol. 32, p. 293). Mr. Jervis appeared in support of the application; the Solicitor General opposed it on the part of Smith's Propeller Ship Company.

Mr. Grantham, civil engineer, Liverpool; Mr. Slaughter, of the firm of Messrs. Stothert, Slaughter, and Co., of Bristol; Mr. Guppy, of the Great Western Company; Capt. Smith, of H. M. S. *Rattler;* Mr. Langdale, the engineer of the *Rattler;* and Mr. Murray, assistant-engineer, Woolwich Dockyard—all gave evidence in favour of the utility of the invention. Mr. Slaughter stated that his firm had fitted three vessels with Woodcroft's screw propeller, two of which were the fastest boats not only in Bristol, but he believed in the world. With this propeller he had attained a speed of 14 miles an hour (!) while with others he had only secured a speed of seven and eight miles an hour. Captain Smith read the following memorandum which he had made of the result of the trial of a Woodcroft propeller fitted to the *Rattler:*—"I think Mr. Woodcroft's spiral propeller superior to any yet tried in the *Rattler.* It has less vibration, less fuel is consumed, with fewer revolutions and greater speed; consequently there is less 'slip.' On the 25th of February the result of going with a head wind blowing hard, was better than heretofore." Mr. Murray reduced the difference in favour of Mr. Woodcroft's propeller to one-sixth of a knot per hour, but added, that "he was aware that by other experiments (than those referred to) Mr. Smith's screw had attained a greater velocity."

The expenses incurred in obtaining and working the patent was shown to have exceeded £1,200, while only £455 had been earned, of which £435 still remains to be received.

The Solicitor General opposed the extension of the patent chiefly on the ground that the increasing pitch could only be of advantage where an entire screw was used, or a screw of at least one entire convolution; while experience had shown that a screw formed of two half turns answered better than any other; but the learned gentleman called no witnesses.

Lord Brougham delivered the judgment of the Council. His lordship gave it as his own opinion on a scientific point, that Mr. Woodcroft's invention was a most ingenious application of mathematical principles to mechanical ends. The Council had decided that a period of six years should be given by way of extension to the petitioner.

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*An Automaton Singer.*—Faber's mechanical man is said to speak English, 'with slight German accent.' The names of all the states and territories even such as Mississippi, Alabama, and Virginia are uttered by the machine, so that they are heard clearly and fully in every part of the room. So also the names of the principal European cities. The word 'Philadelphia,' was pronounced almost as plainly as it could be uttered by a human being. This part of the exhibition produced the liveliest feelings of wonder and delight. The next display was a tune sung by the automaton, accompanied on the organ by Mr. Knuff. Some passages of this tune were given in a truly admirable manner, while the imitation of the human voice throughout was indeed surprising. The automaton next sang a well-known air, and was accompanied by a gentleman on the piano During the evening, the machine not only imitated the tones of the human voice, but the lower, even to a whisper. The exhibition throughout was most successful and triumphant for the truly ingenious inventor. The applause at times was most enthusiastic, and the first air of the automaton with the organ accompaniment, was cordially encored.—*New York Herald.*

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## ORTON'S PATENT LIFE BOAT.

Fig. 1.

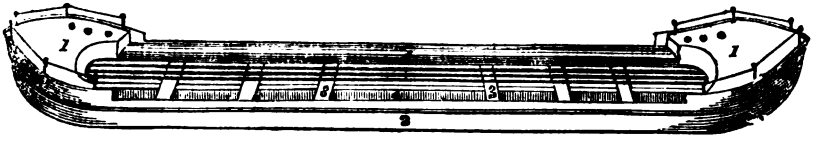

Fig. 2.

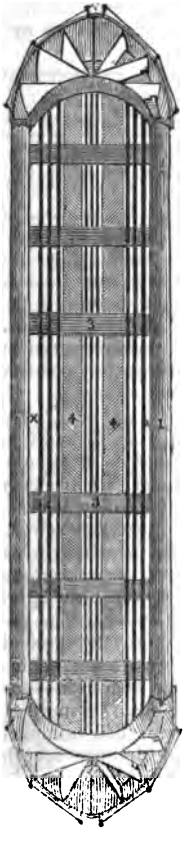

Fig. 3.

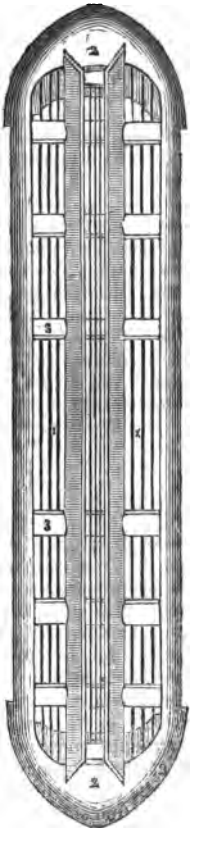

Fig. 4.

Fig. 5.

## ORTON'S PATENT LIFE BOAT.

[Patent dated Oct. 27, 1845. Specification not yet Enrolled.]

We like the construction of this life-boat exceedingly. It seems to us so judiciously and skilfully planned that it can hardly fail of being pre-eminently successful.

Fig. 1 is a side-view of the boat; fig. 2 an inside view; and fig. 3 a bottom view. Length, 26ft.; breadth, 6ft.: depth of side in the middle of the boat, 1½ft.; rise of stems above the gunwale, 1ft.; rise of stems above the lateral cylinders, 1½ft.

1 1, Are lateral cylinders (1 foot diameter) and end cases, made of metal, and divided into numerous compartments, confining upwards of three hundred gallons of air.

2 2, Wood casing, frming the outer facing of the boat, and a protection to the internal metallic parts.

3 3, Six wooden thwarts, strengthening the boat, and contributing to its buoyancy; the centre thwart omitted, to make room for the persons saved.

4, The well, extending from end to end, formed of two planks converging below. The floor of this well is composed of metal rods, extending from end to end. This flooring forms the ballast, which is further increased by cylinders on each side, which, when empty, add little to the weight of the boat, but when full of water, as is the case when the boat is launched, give so much additional ballast.

× × Are strips of wood, extending from end to end, and closing in the spaces between the well and the lateral cylinders.

The arrangement employed for dividing the end-cases into compartments, and at the same time strengthening the boat, is represented in the inside view, fig. 2. From the central and after part of each end-case, there projects seven planks which partition off the end-case into eight distinct compartments, and at the same time by their outer edges support the sides of the boat so completely, that it is almost impossible for her to be stove in about the bows, and should such an accident, under great violence, take place, the injury can only extend to one or two of the compartments, and consequently can little affect the buoyancy of the boat. Three of these compartments at each end, and on the same side of the boat, have a false deck half-way down the bows; these three compartments communicate by many of the scuppers through the partitions. Corresponding to these compartments are three scupper holes through the deck, represented in the side view, fig. 1. These are stopped by heavy metal plugs which rise and fall about three inches. As long as the boat remains right, these plugs close in the scuppers and prevent the entrance of any water which may break over the bow; but if capsized, the plugs fall a certain distance, admitting the water into the compartments as high as the false deck. The boat must in consequence become lopsided, and being so, must of necessity be righted again by the action of the ballast supplied by the well. Having righted, the water taken into the compartments is immediately discharged at the scupper, seen on the inside of the end-case, just above the cylinder in the side-view.

The paddles are represented in figs. 4 and 5 on a larger scale than the boat, for the sake of clearness; one is closed in the act of striking the water; the other is open, the flaps being raised by the action of the water as the paddle is brought back for a second stroke. They are worked under the boat, between the strips, on which they rest by their shoulders, and may thus be worked at any elevation, according to the depth of water the boat may be in. There are twelve, two being worked by each man.

The advantages possessed by these paddles are numerous. They are less cumbersome than oars, which in a heavy seaway are very difficult to work, frequently liable to interruption, and if struck by a sea, are not only liable to be broken, but also by a back stroke seriously to injure the rower. As an instance, a case is related where a man was killed by such a back stroke. The oars also prevent the near approach of the boat to the wreck. The paddles on the other hand obviate these defects, inasmuch as they are not liable to interruption in their operation—do not hold the sea or wind—can be more easily handled—and from their simplicity, require little or no practice for their efficient application. They also attain another material advantage, in allowing the near approach of the boat to the wreck and still keeping her perfectly under command of her crew.

From this description of the boat we

may learn the advantage she possesses over the ordinary boat. Her open structure and her being so low in the water prevent either the sea or wind having much effect in impeding her progress. It is almost impossible for her to capsize, since any power raising one side is immediately counteracted by the depression of the cylinder on the opposite side into the sea, and this from its great buoyancy immediately catches up the boat and keeps her right. If upset, she must right again by the action of her ballast and the system of metal plugs already described. If upset and materially damaged, or prevented righting again, by surrounding bodies, still she is a safe boat, though bottom upwards, since the men within her have an ample supply of air through the grated bottom, while those outside can cling to, or get upon it till relieved. It is hardly necessary to remark that under similar circumstances in the ordinary boat all hands would most probably be lost, and of this we have had melancholy instances.

LONDON FIRES IN 1845—BY MR. W. BADDELEY, C.E., INVENTOR OF THE PORTABLE CANVASS CISTERNS, IMPROVED ENGINE LAMPS, HOSE-REEL, PREVENTOR, FIRE-ENGINE SPREADER, ETC., ETC.

"Woe, when loose from all its ties
And to its growing rage no bar
Swift the conflagration flies,
Like an elemental war,
On each hand, above, around,
Is death and desolation found."—*Schiller.*

"It is of the death-dealing conflagration that we talk.
Not of the pleasant fire that warms and cheers us."—*Toulmin.*

"The statistics of London fires are by no means devoid of interest, and the time may come when they will form an index to the social advancement of the people; for in proportion as houses are built more and more fireproof, and habits of carefulness become more and more diffused, the number of destructive fires will assuredly lessen."—*Knight's London.*

In submitting my sixteenth annual report of London Fires, I have again to congratulate the inhabitants of this metropolis on the diminished number, as well as the trifling character of last year's fires.

Eight hundred and seventy-five alarms of fire have, however, called for the fireman's aid, the particulars of which are subjoined.

While some of our provincial towns and villages have severely suffered from the effects of fire, and the Continent has been the scene of the most awful conflagrations, the number, as well as the extent of London fires has continued to be remarkably small. Of these fires 184 were extinguished by the inmates without external aid; 326 were extinguished by the inmates with casual assistance; while 197 were said to be extinguished by the firemen. This otherwise gratifying retrospect is alloyed, however, by the remembrance, that the fires of 1845 have been of a lamentably fatal character, involving a serious loss of human life, under circumstances the most distressing, as will appear by the following table, and by the remarks which follow it.

| MONTHS. | Number of Fires. | Number of Fatal Fires. | Number of Lives Lost. | Alarms from Chimneys on Fire. | False Alarms. |
|---|---|---|---|---|---|
| January..... | 66 | 2 | 2 | 8 | 8 |
| February ..... | 69 | 3 | 3 | 9 | 5 |
| March ..... | 68 | 1 | 2 | 9 | 6 |
| April,..... | 50 | 1 | 1 | 10 | 8 |
| May ..... | 45 | 1 | 5 | 6 | 1 |
| June.. ..... | 66 | 2 | 3 | 3 | 7 |
| July ..... | 53 | 0 | 0 | 5 | 12 |
| August ..... | 47 | 0 | 0 | 2 | 5 |
| September.... | 50 | 1 | 1 | 7 | 7 |
| October..... | 64 | 2 | 2 | 8 | 11 |
| November..... | 52 | 2 | 3 | 9 | 6 |
| December .... | 77 | 1 | 1 | 11 | 5 |
| Total..... | 707 | 16 | 23 | 87 | 81 |

| | |
|---|---|
| Of these fires, the number wherein the premises were totally destroyed was | 32 |
| Very seriously damaged | 244 |
| Slightly damaged | 431 |
| | 707 |
| Alarms occasioned by chimneys on fire | 87 |
| False alarms | 81 |
| Making the total number of calls | 875 |

| | |
|---|---|
| The number of instances in which insurances had been effected upon the building and contents, was | 313 |
| On the building only | 107 |
| On the contents only | 73 |
| No insurance on either | 214 |
| | 707 |

These particulars of insurance refer exclusively to the property in which the fire originated, no notice being here taken of damages to contiguous premises.

Of last year's fires, the following are worthy of a passing notice :—

January 9, 1 A.M. "Princess Royal," beer-shop, corner of Corporation-lane, St. John's-street-road. Before the fire, which commenced on the ground-floor, was discovered, the flames had communicated to the staircase, and cut off all possibility of escape by that channel. Happily, however, the Clerkenwell fire-escape (one of Wivell's) being stationed directly opposite the premises, two females and a man were rescued from the windows in a state of nudity. The brigade-engines from Farringdon-street, Whitecross-street, and other stations with those of the West of England, and County, soon arrived, and, aided by a plentiful supply of water from the New River mains, succeeded in extinguishing the fire; but not before the house was completely gutted, and the roof seriously damaged.

January 26, 1½ A.M. Dwelling-house of Mr. Brain, Holford-square, Bagnigge-wells-road. A snow storm prevailed at the time, and the wind blew a hurricane. The square being newly laid out, and the roadway unpaved, great difficulty was experienced in finding the plugs and obtaining water, although the New River reservoir was at no great distance. For upwards of forty minutes the fire raged with uncontrolled fury, and a substantial party wall alone preserved the adjoining premises from destruction. The Brigade, West of England, and County engines soon reached the spot, and made the best of the very scanty supply of water that was forthcoming. A good plug of water in Soley-terrace, within fifty yards of the rear of the burning premises, seems to have been overlooked by all parties, or it would have been highly serviceable.

February 10, 2¾ P.M. A fire broke out on board the barque *Henry*, in Blackwall Reach, caused by a boy dropping a lighted candle among some shavings and rubbish between decks. The vessel was at the time taking in a cargo of coals for the Oriental Company's depôt at Aden, and the flames spread through the hull and rigging of the vessel with great rapidity. A steady breeze fanned the flames into great fierceness, and they were visible for miles up and down the river. The awful appearance of the fire was much heightened by the falling snow. A bungling attempt was made to scuttle the ship, and she was eventually run aground by order of the harbour-master, on the north flats off Greenwich point, and left to her fate. The West of England, and two of the Brigade engines, were in attendance, but could not get within effective distance of the barque. The floating engines from Deptford and Rotherhithe might have been usefully employed, but neither of them arrived, and the fire continued to burn during the night, and was only extinguished by the rising tide in the morning.

February 27, 1 A.M. Warehouse of Messrs. Cortauld and Co., crape-manufacturers, 42 and 43, Gutter-lane, Cheapside. On the alarm being given, the parish engine, and two from the Watling-street station, arrived almost immediately. The inmates were seen at the second-floor windows imploring help, their escape being completely cut off; scaling ladders were instantly raised, and the jumping-sheet opened, in which three of the females were caught uninjured, while the other inmates descended the ladders in safety. The flames by this time poured forth with a vehemence that threatened destruction to the opposite houses in this narrow thoroughfare. The West of England and Brigade engines from other stations having arrived, and a plentiful supply of water being obtained, the firemen exerted themselves with their wonted skill and intrepidity, and soon mastered the flames in gallant style, to the unspeakable joy of the neighbours, who had scarcely ventured to hope for such a happy result. The lower part of the premises was burned out, and the upper floors seriously damaged by fire, smoke, and water.

March 2, 7½ P.M. Messrs. Enderby's patent rope, twine, and canvass manufacturers, East Greenwich. When first discovered, the fire was raging in the rope-walk at the rear of the manufactory, in which it had made considerable progress; a private fire-engine was set to work, and messengers dispatched for more effectual assistance. Two parish-engines from Greenwich hastened to the spot, closely followed by one from Deptford dockyard, with a strong body of police, who exerted themselves with great zeal and judgment, under the directions of Inspectors Douglas and Miller, of the R division. At a later period, the Brigade engine from Southwark Bridge-road, with half-a-dozen men, reached the spot, but from the smallness of their force, and their limited quantity of leather hose, their efforts were much circumscribed. The extent of the premises through which the fire communicated, the numerous points at which its progress had to be stopped, and the distance of the water supply, presented so many obstacles, that the suppression of the fire was accomplished with great difficulty. By the combined exertions of those present, the fire was ultimately mastered, but before this was effected, the water-side factory, containing joiners' workshops, spinning, carding, and weaving rooms, with their costly and unique machinery, was completely destroyed. The weaving shop, fronting the factory, the hemp and spinning-room over the engine and boiler house, and the dwelling-house of Mr. Enderby, were very seriously damaged. The floating-engines from Deptford and Rotherhithe, would have been of infinite service upon this occasion, but did not arrive, although the fire was distinctly visible at both these places.

March 14. Gutter-lane was again the scene of danger, from a fire which broke out at midnight in the premises of Mr. Newton, No. 31. As in the former case, it commenced in the ground-floor, from whence it was rapidly progressing upwards. Similar attend-

sace and exertions were again crowned with success. Both these fires were splendid stops.

May 27. A most disastrous fire broke out at Raggett's Hotel, Dover-street, Piccadilly. The house was at the time occupied by families of distinction, and was not yet closed for the night, when one of the inmates, in passing a bed, unknowingly set fire to the curtains, and quitted the room for a few minutes; on her return she found the apartment in flames, and an alarm was instantly raised. The Earl and Countess of Huntingdon had just returned from the play, and were about retiring for the night, when the cry of "Fire" rang through the house. The Earl instantly rushed upstairs to the apartment where his infant son was sleeping, and having awoke the nurse, and told her the house was on fire, he caught up his child, and returned downstairs; passing through the flames, he escaped with a slight scorching. Two of Mr. Raggett's sons made a gallant, and, happily, a successful effort to save their mother, who was confined to her bed on the second floor, with a broken leg; the young men were nearly overpowered ere they reached the street with their precious burden, but with assistance they accomplished their object. While this was going on, a neighbour proceeded to St. James's Church for the fire-escape, which was brought with less expedition than could have been desired, owing to the gross misconduct of the man having charge of it. On reaching Dover-street, it was raised against the burning building, but before it was properly placed, Miss Raggett, rendered desperate by fear, made a spring towards it, and, missing her aim, fell with great violence on the pavement, and was taken up a corpse. The fire-escape conductor rendering no assistance, Mr. H. Raggett ascended, and got Miss Round and her maid safely into the escape. Other inmates escaped in various ways from the imminent peril in which they were placed, and in a very few minutes the building was enveloped in flames. The engines of the parish, Brigade, County, and West of England Offices, followed each other in rapid succession, and water being obtained, the firemen exerted themselves to the utmost, their conduct being described on all hands as "*beyond all praise.*" In a short space of time the flames yielded to their prowess, nearly half the front and greater part of the back of the hotel and contents being destroyed.

As soon as the ruins were cool enough to be entered, a search was made, for the remains of those who were by this time known to be missing. The first was Mrs. Jones, nursemaid in the service of the Earl of Huntingdon, whose body was found on some leads over the kitchen, dreadfully burned. Further search disclosed two bodies, which proved to be those of Mr. Raggett, the proprietor, and Mrs. Round, whom he was gallantly endeavouring to save, when overpowered by the smoke and heat, they both sunk to rise no more. The state of the ruins precluded further search till Friday, when another body was discovered, that of Mrs. Barnes, a chambermaid in the hotel. An inquest commenced on the following Wednesday, before Mr. Bedford, the coroner for Westminster, which was adjourned to Friday, when the foregoing facts were minutely detailed in evidence, and the jury returned a verdict of "Accidental Death," accompanied with a request "that the coroner would write to Sir James Graham, Secretary of State for the Home Department, for the purpose of calling his special attention to the evidence given at this inquest, in order that the Government may take measures for preventing in future such a fearful sacrifice of human life."

The excitement occasioned by the last dreadful catastrophe was still further heightened on Sunday, June 1, 1½ A.M., when a fire broke out on the premises of Messrs. Satchell and Robertson, 158, Fenchurch-street, hatters and umbrella makers. The fire seems to have been first discovered by Mrs. Satchell, who, rising in bed half suffocated with smoke, awoke her husband, exclaiming, "Good God! the house is on fire." Mr. Satchell immediately roused himself, but was not nearly so collected as his wife, who urged him to escape by the flight of stairs leading to the roof. They were sleeping in the third floor front room. Seizing his little daughter he made his way through the smoke to the roof, supposing his wife with her infant son was following him. Mr. Robertson (a brother of Mrs. Satchell's,) who slept on the second floor, had been previously roused, and running up stairs gave an alarm at Mr. Satchell's door, but the smoke was so dense, that he was unable to wait their answer, and made the best of his way through the roof. Mr. Isaacs, the housekeeper of the Frenchurch Chambers, adjoining Messrs. Satchell's premises on the west, was awoke by the crackling of the fire, and on looking out of the window, perceived the back part of the next house in flames. With great presence of mind he rushed up stairs and opened the door in the roof, through which Mr. Robertson, Mr. Satchell and his daughter, and the servant maid, descended in safety to the street. Isaacs then proceeded to extricate his wife and child which he accomplished with great difficulty, the flames having entered his apartment; they escaped with scarcely an article of clothing. The fire had got a firm hold of the lower part of the premises before it was discovered, and rapidly ascended to the upper floors, raging with great vehemence in the rear. From the age of the building, and the quantity and large dimensions of its timbers, abundance of fuel fed the flames, while the absence of party walls involved the adjoining buildings in one common danger. Fenchurch Chambers on the west, and Mitre Chambers on the east of No. 158, were soon on fire. Four parish engines, those of the Brigade, West of England, and County Fire Offices, were promptly in attendance, and water being plentiful, the firemen strained every nerve to prevent the farther progress of the destruction. By dint of the most exemplary exertions the fire was effectually stopped in Nos. 157 and 159, and the main body of fire in No. 158 extinguished. Shortly before this was accomplished it became known that Mrs. Satchell and her infant son had not escaped. As soon as the ruins could be entered, the scaling ladders were raised and the bodies of the unfortunate sufferers found, as expected, just within the window of the third floor front room, at which window they were last seen alive. The mother was in a sitting posture with the infant partly in her lap, both being sadly burned. A coroner's inquest was afterwards held before Mr. Payne, the city coroner, when the jury returned a verdict of "accidental death," and also passed the following resolution. "The undersigned jurors, at the inquest held on Mrs. Satchell and her child, who were burnt at the recent fire in Fenchurch-street, beg very strongly to draw the attention of the Police Committee to the subject of fire-escapes, to be placed under the superintendence of the police, and furnished at every station and other convenient distances throughout the city of London, which the jurors are of opinion would tend to save many lives, and would probably have saved those of the two individuals now under their notice."

It may here be observed, that this locality is particularly well supplied with fire-escapes; there are no less than five sets of fire-ladders within a very short distance of the fatal spot, exclusive of two sets of Merryweather's portable fire-escape ladders, each within a hundred yards east and west of the fire; not one of which has been forthcoming at either of the *three fatal fires* which the writer has attended *in Fenchurch-street!*

August 7, 6½ P.M.. A fire broke out in a straw warehouse belonging to Mrs. Ellis, in Portman-market, which, from the nature of the contents, spread with frightful rapidity, igniting the roof of the market with upwards of twenty loads of straw and four of hay, which were blazing most furiously when the engines of Saint Marylebone parish, the Brigade, County and West of England, under their respective superintendants, reached the spot. The branch of the West of England engine being equip-

ped with the *patent spreader* distributed large quantities of water over the burning matter, extinguishing the flames with astonishing rapidity, and the fire was eventually stayed with much less damage to the adjoining properties than was at one time apprehended.

August 18, 7½ P.M. A fire (*the fire* of the year) broke out in the extensive premises of Messrs. Bradbury, Greatorex, and Co., Manchester warehousemen, No. 6, Aldermanbury. The fire was first discovered burning among some old boxes and waste paper in the basement by the men engaged on the premises, one of whom went down and threw a small quantity of water on the flames, but considering "discretion the better part of valour," he gave up the conflict and ran off for the engines. An immediate alarm was raised, but so extremely rapid was the progress of the flames, that before any assistance could arrive the whole of the lower part of the premises was on fire. In consequence of the early period of the evening, and the brilliancy of the flames, thousands of spectators came flocking to the spot, and crowding into the narrow thoroughfares of this locality, greatly impeded the exertions of the firemen. Considerable time elapsed before a sufficient number of police could be mustered to withstand the pressure of the dense and disorderly mass of spectators; entreaties, threats, buckets of water, carmen's whips, policemens' truncheons, and firemen's hatchets, were alike disregarded, and the furious mob wrenched one of the handles of the West of England engine in two, before the firemen could unlock it. Five parish engines, ten of the brigade, with the County, and West of England, were on the spot in a very short space of time, and water being obtained, were placed in the most efficient position. Some of the authorities having represented the imminent peril in which Guildhall was placed, the stained glass window at the west end being broken by the heat, the County and West of England engines were taken round into Guildhall-yard, and the hoses being let through the Comptrollers'-office, the branchmen were stationed on a lead flat in a most commanding position, taking the fire in the rear, and effectually staying its progress in that direction. By the united efforts of the firemen and others, before 10 o'clock the fire was subdued, and all apprehensions of further danger at an end; but in addition to the great destruction of property in Messrs. Bradbury and Co.'s warehouse, very serious damage accrued to the adjacent properties, and the total amount of damages was estimated at very nearly 200,000*l.* The most remarkable circumstances arising out of this fire, were the holding of a coroner's inquest to ascertain the cause of its origin, and an increase in the rates on insurance of such premises.

September 16, 1¾, P.M. An alarming fire broke out in the turpentine warehouse of Messrs. Price and Co., in William-street, Blackfriars. At the time of the outbreak the workmen were gone to dinner, the only person in the yard being one of the ostlers, who perceiving a dense volume of black smoke issuing from the upper floor of the turpentine warehouse, raised a cry of "fire." Mr. Connorton, superintendent of the West of England fire-office, being on the spot, despatched messengers for proper assistance, and ordered the yard gate to be kept shut until it arrived. The Bridewell engine came first, was placed at the waterside, and preparations made for getting it to work, but not being accompanied with a sufficiency of leather hose to reach the fire it was useless, and was removed to give place to the Farringdon-street engine, which next arrived. The few minutes thus lost, however, led to most disastrous results, the flames gaining an ascendancy, which nothing could afterwards check. Engines from the other stations followed each other in rapid succession, and an excellent supply of water was obtained; the floating engine from Southwark-bridge was brought up and laid alongside the burning building, into which it threw torrents of water but with little visible effect. The most strenuous efforts were making for the suppression of the flames, when a little before three o'clock the upper floor gave way, which sent a mass of ignited turpentine, amounting to nearly thirty tons, through the windows and doors on to the wharf, and from thence into the barges, &c., alongside. The Farringdon-street engine, on the wharf, was enveloped with liquid fire, and soon burnt to ashes, the men who were working it escaping with difficulty by precipitating themselves from the wharf. One unfortunate man, mistaking the way, ran into a corner where his further progress was stopped, and he was burnt to death. The liquid fire having fallen into and around the barges lying off the wharf, they were soon in flames, as was also the Floating Fire-Engine, from which all hands were compelled to make a precipitate retreat.

This powerful auxiliary being placed *hors de combat*, the County and West of England engines were united by a breeching, and ably supplied its place, pouring a well-directed torrent of water into the burning premises with the best effect. By the united efforts of all present, the flames were got under before four o'clock. Much fear was at one time entertained for the safety of the City Gas-works, but no grounds existed for any such apprehensions. Messrs. Price's turpentine warehouse, on the west side of the wharf, with its contents, was entirely destroyed; the oil-warehouse on the east side, as well as the cooperage, were severely damaged. The premises of Messrs. Capel, and of Mr. Hoppe, coal-merchants, and a number of barges belonging to these firms, were seriously damaged. A coroner's inquest was held on Thursday on the body of the unfortunate deceased, who proved to be a man named Spencer, aged 21, who obtained a precarious livelihood by working as a porter, in Farringdon-street, calling the firemen, and working the engines at fires. The jury returned a verdict of "Accidental death arising from a fire, but how that fire originated there is no evidence to show."

Oct. 9, 7½ P.M. A fire broke out in Asylum-row, Westminster-road, on the premises of Mrs. Jones, firework-maker, through the carelessness of a boy in trimming a lamp, from which a spark fell among a quantity of squibs, (about three gross;) these instantly exploded, and communicated with the rest of the stock. At this time, four women, four children, and a man, were engaged in the first floor, tying up fireworks, all of whom were safely extricated with the exception of Mrs. Jones' mother, Sarah Fields, (better known as Madame Hengler,) aged eighty years. She was sitting by the fireside when the explosion took place, and from corpulence and debility, as well as being a cripple, was so helpless that she could not leave her chair. Some men procured a ladder, which they raised to the first-floor window and nearly succeeded in extricating the unfortunate woman, but were driven back by the overpowering fumes of the sulphur, and she perished. The Brigade and West of England engines and men were on the spot in a few minutes, and soon extinguished the fire, when they found the corpse just within the window. A coroner's inquest returned a verdict of "Accidental Death."

November 15 ½ A.M. Another lamentable fire, attended with loss of life, broke out in Tabernacle-square, on the premises of Mr. Moore, at the well known baths of St. Agnes le Clair.* The fire was first discovered by a police-constable, who had great difficulty in arousing the inmates to a sense of their peril. The sound of the rattle bringing assistance to the spot, an effort was made to rescue the inmates of the devoted building: a ladder was speedily obtained and raised to the front window, and several of the parties brought down in safety. A set of Merryweather's portable fire-escape ladders were

* More than three centuries ago this spring was a well-known landmark, then called the well of "Dame Annis the Clere," sometimes "Dame Agnes the Clere;" the *canonization* is of modern date.

brought from Shoreditch parish, and taken round to the rear of the premises, but before they arrived Mr. C. Moore precipitated himself from a back window, and, falling on a water-butt, was seriously injured. The Brigade engines from Whitecross-street and Jeffrey-square were promptly on the spot, and placed in front of the premises, while Clark, the parish engineer of Shoreditch, took up a position in the rear. An abundant supply of water being obtained, the engines were soon in full operation, and the flames having communicated to the Angel and Crown adjoining, for some time threatened its destruction. Owing to some unfortunate misapprehension, the call was not properly forwarded, and a considerable time elapsed before any further assistance reached the spot. The engine from Watling-street subsequently arrived, as did also the West of England, which had at the outset been turned back. As soon as the ruins could be entered, the body of Mrs. C. Moore was found lying on the partly consumed flooring of the second-floor back room, dreadfully disfigured; her son (by a former husband,) was also found in the remains of the bed on which he slept, and from which he appears never to have risen. His mother would seem to have been making for the window through which her husband had precipitated himself, when overpowered by the smoke, or from the effect of fear, she fell upon the spot where her blackened corpse was eventually found. A coroner's jury returned a verdict of "Accidental Death."

December 5 ½ A.M. A fire very nearly attended with fatal consequences, broke out at No. 9, Bedford-place, Commercial-road, St. George's in the East, in the occupation of Messrs. Cooper and Willard, shoe-manufacturers. At the time of the outbreak nearly a dozen persons were asleep in various parts of the premises. The fire began in the front shop, and spread so rapidly, that the sleepers in the back part escaped through the window with great difficulty, while those in the upper floor were in still greater peril. From the first it was pretty well understood that a bed-ridden female, eighty-three years of age, who slept in the first-floor front room had perished; indeed no effort was made to effect her rescue. The fire had raged most furiously in the shop and up the back part of the house; the flames had penetrated through the floor and entered the apartment occupied by the aged invalid, but had been extinguished by the water thrown in by the engines. As soon as the fire was got under, a ladder was raised to the front window, and the firemen, to their great surprise on entering the apartment found the poor woman crouched up in bed, *alive!* On perceiving them she said—"Oh dear, here I am, very poorly; is the fire out? Give me a drop of water." She was at once got out of the ruins, and taken to a neighbouring house, and, to the great joy of all, was found to be unhurt. Her preservation amidst the smoke and heat to which she was exposed for nearly two hours, was very remarkable, and furnishes a striking and salutary caution against the premature abandonment of every possible exertion to rescue a fellow-creature from such imminent peril.—"While there is life, there is hope!"

The following list shows the occupancy of the various premises, as regards that portion of them in which the fires occurred, illustrating the comparative liability to accident by fire of various trades, manufactories, and dwelling houses.

| | |
|---|---|
| Apothecaries, chemists and druggists | 9 |
| Assembly-room | 1 |
| Bakers | 18 |
| Basket-maker | 1 |
| Bath | 1 |
| Beershops | 6 |
| Booksellers, binders and stationers | 11 |
| Boot and shoe-makers | 8 |
| Bottle warehouse | 1 |
| Bridge | 1 |
| Brokers and furniture dealers | 4 |
| Brush-makers | 1 |
| Builders | 11 |
| Cabinet-makers | 7 |
| Card-makers | 3 |
| Carpenters and workers in wood | 19 |
| Chair-maker | 1 |
| Chandlers | 4 |
| Cheesemongers | 2 |
| Chemical works | 1 |
| Church | 1 |
| Clothiers | 4 |
| Coachmakers | 3 |
| Coal merchants | 2 |
| Coffee-shops and eating-houses | 2 |
| Colour makers | 5 |
| Coopers | 2 |
| Cork-burners | 2 |
| Corn-chandlers and dealers in hay and straw | 6 |
| Crape manufacturer | 1 |
| Distillers | 6 |
| Drapers, linen and woollen, hosiers and silk mercers | 20 |
| Dwellings | 249 |
| Emery-paper maker | 1 |
| Engineers | 2 |
| Farms | 4 |
| Feather merchants | 2 |
| Fellmongers | 2 |
| Firewood-makers (patent) | 2 |
| Fireworks, makers of and dealers in | 9 |
| Gas works | 3 |
| Glass works | 1 |
| Grocers, &c. | 13 |
| Gunny-bag maker | 1 |
| Hatters | 8 |
| Hotels and taverns | 10 |
| Japanners and table-cover makers | 5 |
| Lamp-black makers | 3 |
| Laundries | 2 |
| Leather-dressers | 3 |
| Lighterman | 1 |
| Lime barges | 2 |
| —— wharf | 1 |
| Lucifer-match makers | 5 |
| Maltsters | 1 |
| Marine stores, dealers in | 2 |
| Mattress-makers | 2 |
| Musical-instrument makers | 2 |
| Oil, refiners of | 1 |
| Oil and colourmen | 13 |
| Oil and turpentine warehouse | 1 |
| Nursery | 1 |
| Paper stainers | 1 |
| Papier maché manufacturers | 2 |
| Pastry-cooks | 2 |
| Plumbers, painters and glaziers | 2 |
| Pottery | 1 |

| | | | |
|---|---|---|---|
| Printers and engravers | 5 | Theatre | 1 |
| Proof-house | 1 | Timber merchant | 1 |
| Quill dresser | 1 | Tinmen, braziers and smiths | 4 |
| Refiners | 2 | Tobacconists and cigar makers | 3 |
| Rope-maker | 1 | Tool-maker | 1 |
| Sale shops and offices | 33 | Trimming manufacturers | 2 |
| Saw mills (steam) | 3 | Turpentine works | 2 |
| Schools | 3 | Under repair and building | 11 |
| Scum boiler | 1 | Unoccupied | 3 |
| Ships | 11 | Varnish-maker | 1 |
| Skin dressers and dyers | 3 | Victuallers, licensed | 31 |
| Soot merchant | 1 | Wadding manufacturer | 8 |
| Stables | 11 | Warehousemen | 6 |
| Straw-bonnet makers | 3 | Wine and porter merchants | 7 |
| Tailors | 17 | Wheelwright | 1 |
| Tallow melters | 4 | | |
| Tarpaulin maker | 1 | Total | 707 |

The number of fires on each day of the week was as follows :—

| Monday. | Tuesday. | Wednesday. | Thursday. | Friday. | Saturday. | Sunday. |
|---|---|---|---|---|---|---|
| 100 | 108 | 113 | 94 | 98 | 95 | 99 |

The hourly distribution throughout the day and night was the following :—

| | First Hour. | Second Hour. | Third Hour. | Fourth Hour. | Fifth Hour. | Sixth Hour. | Seventh Hour. | Eighth Hour. | Ninth Hour. | Tenth Hour. | Eleventh Hour. | Twelfth Hour. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A.M. | 50 | 44 | 29 | 17 | 10 | 8 | 15 | 13 | 17 | 12 | 15 | 17 |
| P.M. | 20 | 21 | 23 | 28 | 24 | 29 | 42 | 45 | 49 | 81 | 59 | 39 |

The causes of fire, so far as they could be satisfactorily ascertained, were as follows :—

| | | | |
|---|---|---|---|
| Accidents, for the most part unavoidable | 12 | Fumigation, incautious | 3 |
| Apparel ignited on the person | 3 | Furnaces, overheated, &c. | 17 |
| Candles, various accidents with | 69 | ———, combustibles laid near | 9 |
| Carelessness, palpable instances of | 13 | Gas, accidents in making | 3 |
| Cats among lucifer matches | 2 | ——, ——— lighting | 10 |
| —— knocked down horse of clothes | 2 | ——, ——— from escape of, | 34 |
| Children playing with candles | 3 | ——, left burning too high | 7 |
| ——————— fire | 9 | Glue, heating of | 7 |
| ——————— lucifer matches | 7 | Gunpowder, explosion of | 1 |
| Cinders put away hot | 10 | Hearths and floors, fires kindled on | 9 |
| Curtain, bed, ignited | 49 | Hot-water pipe | 1 |
| ———, windows | 47 | Kilns overheated | 3 |
| Distilling spirits | 5 | Lamps | 5 |
| ——— turpentine | 2 | ———, naphtha | 6 |
| Drunkenness | 7 | Lime slaking | 9 |
| Fire sparks | 24 | Linen, drying or airing before the fire | 28 |
| Fires raking out | 3 | Lucifer matches, making | 5 |
| Fire-works making | 4 | ———, using | 5 |
| ——— letting off | 6 | Naphtha, rectifying | 1 |
| Flues blocked up | 7 | Ovens, defective | 3 |
| —— defective | 19 | ———, overheated | 5 |
| ——, foul, ignited | 39 | Oil, boiling of | 1 |
| —— overheated | 13 | Poker left in fire | 1 |
| Friction of machinery | 1 | Shavings, loose | 18 |

| | |
|---|---|
| Spontaneous ignition of damp, canvass.. | 1 |
| ——— Charcoal .... | 1 |
| ——— Dung..... | 2 |
| ——— Elder flower leaves and lard | 1 |
| ——— Gunny bagging | 1 |
| ——— Hay ..... | 2 |
| ——— Lamp black .. | 6 |
| ——— Lucifer matches | 2 |
| ——— Oil in cold process of refining | 1 |
| ——— Rags ..... | 1 |
| ——— Sweepings .,.. | 1 |
| Stoves improperly set ..... | 13 |
| ———, drying ..... | 14 |
| ———, hot air..... | 2 |
| ———, pipe..... | 10 |
| ———, charcoal..... | 4 |
| ———, overheated..... | 8 |
| Suspicious..... | 9 |
| Sulphur, melting of,..... | 1 |
| Tallow, ditto ..... | 3 |
| Tar and pitch, ditto..... | 4 |
| Tobacco, smoking..... | 19 |
| Turpentine, &c., drawing off..... | 3 |
| Varnish making..... | 4 |
| Wilful..... | 14 |
| | 675 |
| Unknown ..... | 32 |
| | 707 |

The causes of fire, it will be seen, are much of the usual character. The careless throwing about in the streets of unextinguished cigar ends has led to a number of accidents besides those which are included in this report. Some inconvenience was occasioned at the office of the *Mechanics' Magazine* in May last, by this reprehensible practice.

The extended use of turpentine under its modern names of *naphtha*, *camphine*, &c., has also caused numerous accidents, and it is much to be regretted that a better knowledge of the character of this dangerous compound does not prevail. The following fatal accident illustrates the ignorance that exists on this head:—In the early part of last year, Mary Spencer, cook in the service of a gentleman residing at Battersea, wanting a light to go to bed by, poured some spirit of *camphine* into a tea-cup, and placing a floating wick therein, lighted it and was proceeding up stairs when the spirits ignited and set fire to her clothes, burning her so severely as to cause her death.

"No accidents are so unlucky, but that the prudent may draw some advantages from them."

*(To be continued in our next.)*

## THE SEPTENARY SYSTEM—REPLY OF MR. JOPLING TO "CENTURION."

Sir,—If I was not fully convinced that a complete illustration of "the Septenary System" would be useful, I should not have written so frequently on the subject, or have now noticed "Centurion's" letter to you on the same.

So many papers on the Septenary System have appeared in the *Mechanics' Magazine* it is impossible to know to what particular curves the doubt refers. If I may judge from the term "intersection which generate the curves," &c., "Centurion" is one of Mr. Mac Laurin's school, to whose method Lord Brougham referred me, but which I had seen more than twenty years before.

But no instrument can be made either at little cost, or to work accurately on the intersection, on Mr. MacLaurin's principles, and most certainly not any on a large scale. Now, the great facility with which many varying curves in the Septenary System can be described on large scales with great accuracy, has been the principal inducement for my perseverance.

So many eminent mathematicians have seen my instruments, and many of the curves produced by them, and have acknowledged the originality of my invention, that I have nothing to fear from further investigation, to say nothing of the specimens of curves which have been buried so long at the Royal Societies of London and Edinburgh, the Institution of Civil Engineers, the Society of Arts, &c., and amongst which are some of the finest specimens I ever produced.

However, I never professed to be a mathematician, and I do not consider in the strict sense of the word, that it is any more essential to the understanding of the Septenary System than it is for a person to know the equations of a circle or an ellipsis, in order to know the different methods by which they may be drawn or described, or to know and judge of their forms by sight.

I have frequently thought that had I been a mathematician, in the strict sense of the word, in all probability the Septenary System would never have been formed: I should have looked at my discoveries through the equations, and might not have become so familiar with so great a number of laws, or perceived so obviously by the practical geometry

the system the family likenesses and relations throughout the whole, as I have obtained by the mechanical operation of the instruments, and seeing the true lines themselves.

Having obtained a series of true lines, and the register for their reproduction, I not only know how to set any particular instrument again for those particular lines to any scale, but also an indefinite number of others, without the laborious research which would be requisite if sought for through the equation.

I am very far from wishing to underrate the great importance of the higher branches of mathematics; but equations do not give the distinct notion of many lines, and parts of lines, which in application frequently are only required, which is produced on contemplating these lines when they have been drawn by a correct instrument.

The quotation which you recently made from Dr. Whewell, p. 137, is to the same purport, but better expressed than I can.

Has "Centurion" seen vols. 8 to 13 of the *Mechanics' Magazine?* or did he refer to them at the time he wrote his letter? If he did, I fear I should not be able by anything I could say, short of the complete illustration, to make him understand me.

From what I remember to have heard in a conversation between the late Mr. Davies Gilbert and Mr. Babbage, at the Astronomical Society, in reference to the apparatus and the curves I then exhibited—both curves and apparatus were considered new, and their different methods of investigation of some of them new to each other. By the former gentleman and Mr. Hume, I was introduced to a committee in the House of Commons to exhibit what was then at any rate considered to be new.

If mathematicians ask why I have not attended more to the higher branches, I might enquire of them why they have not attended more to the practical geometry of the system? My chief object has been application.

I may just observe that the system was formed and many curves drawn by means of a piece of tracing paper, laid and moved upon a piece of writing paper; and any motion in the whole system may be explained, personally by those means and a pencil, if any person would have the patience to go through so tedious an operation.

I may also refer to the fact of the five gentlemen from the Navy Board, who were with me as many days, and amongst other statements came to the conclusion that what they had seen "might lead to the development of principles in some way useful to the naval architect," to show that what I had done was considered new at that time.

I think I may now refer to the last lecture of Professor Cockerill, to show the necessity of a more extensive *practical knowledge* of mathematical curves, especially such as can be easily described, than architects can at present possibly have any knowledge of, from the fact that they have not a sufficient number of correct examples to judge from, or know anything of the way by which many that are applicable can be practically described.

The professor is reported to have said that the profile of the columns of the "Parthenon" had been determined by Mr. Penrose to be "hyperbolic and no other."

Whether it is that mathematical line, or any other mathematical lines the Greeks have introduced in their substantial or the more ornamental parts of their works, which on contemplating gives so much pleasure and satisfaction at the present day—it must be obvious that they must have intimately known those lines before they could have applied them: not their equations, but the lines themselves.

I was certainly surprised to find in the report of the same lecture, that the professor actually recommended "four-centred arches." There would have been a nearer approximation to a true line if he had recommended parts of circles to be patched together to form the profile of the column of the Parthenon. But "four-centred arches" are as false as the joining of four parts of circles together and calling the figure, or substituting it for, an ellipsis. Or as false as patching a number of arcs of circles together and calling the line a spiral—or the Greek volute—the peculiar character of which I have already described in your pages.

Is "Centurion" aware that Sir Isaac Newton and others have said those lines are to be preferred which can be the most easily described—not those which merely have the more simple equations; and that a good easy description of curves was a desideratum?

What I have said respecting the eye, is, that it is a good mathematician when it has been taught, but not, at any rate, always so till then. How can it be taught better than by seeing, contemplating, comparing, and drawing from the most perfect examples, described on the most perfect plane possible, and on as large a scale as is convenient? The eye should also be taught to know what will deceive, and make a line appear different to what it really is.

The late Mr. Tredgold in a paper read at the Institution of Civil Engineers, considered my invention so important, that he compared it to the discovery of the cipher in arithmetic.

In conclusion, if "Centurion" will permit you to favour me with his name, I will, if it should appear desirable, appoint a time, and not only show him a variety of instruments, but the lines they have produced, if he will undertake to report the interview, and, if necessary, point out the best plan for bringing the whole before the public, and send it to you for insertion in your pages, with his proper name and address attached.

I am, &c.,

JOSEPH JOPLING.

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MISCELLANEA MATHEMATICA.—NO. VIII.

## *Mathematics as a Branch of Professional Study.*

It cannot be denied, that the kindred professions of architecture and engineering require to be based upon principles in pure mathematics; still less can it be denied that the professors themselves are *in general* but little versed in that essential branch of their respective professions. In fact, we can scarcely take up a professional book, in which there is the slightest approach to mathematics, without feeling convinced that the author is handling unfamiliar tools, and often lacerating his professional character by his clumsy use of them. Often have we felt a suffusion of shame when consulting works of the most eminent men in these professions, and stumbling on their ludicrous attempts to talk mathematically; and we have felt pleased in thinking that such jejune productions do not fall under the eyes of mathematicians. They know too well that our professional works contain nothing calculated to repay the trouble of perusal, much less the expense of purchase.

Yet problems of great, very great mathematical difficulty, are daily occurring in both professions. What is the consequence? That our architects and engineers are compelled to trust to unsatisfactory and illusive experiments with models, or to risk at once the consequences of their conjectural designs. They sometimes succeed—*often* when they keep pretty close to older and tried plans—but occasionally the most lamentable failures take place, and sometimes attended with fearful loss of life as well as property. A moderate portion of mathematical skill would have prevented these and other evils.

Again, the unnecessary strength given to parts of a structure, and unnecessary demand of generative power in machines, are so common, that there are perhaps few buildings or machines at present in existence which form entire exceptions to the charge. Now the strength of a structure is, in reality, the strength of its weakest part, and even the weakest part may be weakened still more by its connection with the other parts; and the power of a machine is only that part of the initial force which is effectively conveyed to the "working points." All else is wasted, whether of strength or power; and, in fact, so much capital might as well be thrown into the ocean at once, as employed in these unprofitable parts of a structure or an engine.

A competent knowledge of mathematical science would enable the professional man, *in a very great degree*, to avoid this profusion of expenditure, and in nearly every case to prevent those frightful catastrophes that are periodically occurring from falling buildings and exploding machinery. Even on the inquests to which these terrible fatalities give rise, the conflicting and often very absurd testimonies and opinions of professional men are most remarkable; and they are gradually convincing the public that the professors themselves are destitute of all accurate knowledge of the *principles* of their own art, and are guided by mere empirical rules, the slightest departure from which becomes professional temerity, and a most wanton sporting with property and life! Is this as it should be?

Were architecture and engineering empirical arts—were it not possible to determine *à priori* the results of all stru-

and pressures in a building, and the loss of power attendant upon any given train of machinery—were it not possible to compute, by unerring rules, the actual force and its direction at any given point, either of a structure or a machine—then, indeed, this reproach could not lie at the door of either profession or of its Institute. Since, however, *they need not be* empirical professions, and as a comparatively moderate acquaintance with mathematical science would redress the greater part of the wrongs which professional ignorance inflicts on the public, it behoves us to make such corrections ourselves, lest they be forced upon us in a more galling form by the decision of the legislature. In fact, as any person, no matter his ignorance of all that relates to the subject, may at his pleasure dub himself "C. E." or "Architect," and as in the recent railway manis, so many of the most unprincipled and unpractised persons have thrown themselves into the engineering profession, we need not wonder, nor indeed should we be sorry to see it, if the legislature should find it necessary to exercise a control such as it does in *law* and *medicine*. It certainly does seem necessary to put some restriction upon the power of incompetent persons to enter these professions; and no mode seems so practicable as a charter of incorporation and a board of examiners to decide upon the qualifications of candidates in each of the professions. We are sure it would be a boon to the public, and not less a boon to the professions themselves. It would secure to the public qualified artists; it would remove from the professions that load of discredit which the present open system inevitably entails upon them, and with increasing accumulation each successive year.

We scarcely, however, hope to see this desired consummation yet; but we do know, from many letters which we have received, that a great number of the younger members of both professions are anxiously desiring to *qualify themselves* for an efficient and honourable execution of their duties. We have often been requested to point out a suitable course of study and reading in mathematics, which shall mainly, if not wholly, have a direct professional bearing—including all the great features of what is essential, and precluding those inquiries which, however interesting to professional mathematicians, are superfluous to professional architects and engineers. Yielding to none in our wishes to be "useful in our day and generation," we shall attempt to point out, not only the subjects, but the manner of study which appear to us to be best adapted to the end in view; and we trust that should the day come—which we yet hope to see—when some test of capability for professional duties shall be rendered legally imperative, the suggestions which we may offer will have proved a beneficial aid to many a one qualifying himself, who would otherwise have been unable to do so, in that most important branch of his acquirements, the *mathematical*.

Although large premiums are paid with articled pupils both to architects and engineers, we believe there is not a single case producible, in which the slightest attention to mathematical studies is included in the course of professional instruction. How, indeed, should there be? The youth may be advised, or he may not be, "to get a few lessons in mathematics from some private teacher;" but in most cases the advice will be looked upon as a bore, and perhaps given with a half sneer; and even if adopted, he is left, like his tutor, in the dark as to the nature and character of the mathematics that he wants. He blunders through a few lessons, gets disgusted, and his mathematical course is finished with the payment of his first guinea!

A few years ago an attempt was made to procure for young men a preliminary scientific education, prior to their going into articles, and a "College for Civil Engineers" was formed on the *joint-stock* principle, which after a while settled down at Putney. It was, however, a mere commercial speculation, and fared as a great number of that class of schools has fared, in becoming all but insolvent. A *military governor* was selected, and a system of *military regulations* and practices was adopted for training boys for *civil and scientific employments!* A good deal of curious matter is connected with the history of this institution; but the military system not only failed to produce good scholars, but it succeeded in creating a spirit of reckless dissipation that rendered it a scandal and a nuisance to the district in which it was "located." In fact it was all but bankrupt in means, as it actually was in character. We are, however, much gratified to learn that *now* its character is totally changed; that so-

cial decorum and gentlemanlike conduct as much distinguish the present race of students as the former race were oppositely distinguished. But it is now under the direction of a civilian and a clergyman,* with absolute power over all the arrangements and details of the Institution. We hear on all hands that its proceedings are judicious and effective; and with the belief that such is the case, we wish it all prosperity!

This college, however, can only educate a small number in comparison with the annual influx of youths into professional offices. It is for the use of those who have no other director that we write. Throughout our series of articles we shall keep the one grand end in view—that of mathematics required by the practical architect and engineer.

It might seem to some of our readers that whilst we reflect upon the present imperfect state of mathematical knowledge in the civilian professions, we ought also to notice the condition of the Military, or Royal Engineers. Seizing as they do upon the "good things" which Government has to bestow, and looked up to by the public as men immensely superior in abilities and learning to the civil engineer, it is natural for us to scrutinise *their* system of training, and the degree in which their exalted pretensions are borne out by facts. Educated in a school set apart for the one object of preparing the Ordnance officers for their onerous duties, we should be led to think that their training was in every way a model of theoretical and practical education. Alas!

We shall, however, some day ere long devote a few passages to this topic, when we think some facts will be brought to light which will astonish our readers. For the present we shall proceed with our suggestions to the civilian:—that is, in our next Number.

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### ANALOGY BETWEEN MR. PARSEY'S "REGULATING RECEIVER" AND THE ORDINARY STEAM-BOILER.

Sir,—The defect inherent in Mr. Parsey's system of applying compressed air has been so definitely pointed out by two correspondents in your last Number as to render further remarks upon it superfluous. My object is not to comment on their conclusions, which in substance are obviously correct, however much the degree to which they reduce the utility of the engine may be modified by altered arrangements and change of relative density between the air in the reservoir and that admitted to the working cylinders. But I wish to direct the attention of your readers to the neglected fact, that this process of profitless expansion, the evil of which has been so fully indicated, is by no means peculiar to the engine in question, but operates in a greater or less degree in every steam-engine, where in the *mass of water* interposed between the fire-surface and the working cylinder we have in effect a "regulating receiver" which reduces the primary elastic force of the steam in a manner quite analogous to Mr. Parsey's intermediate cylinder. As in the latter, air of an extreme elastic force is permitted to expand till reduced to a moderate specific pressure,—losing in power as it gains in volume; so in like manner, in the former, we have steam of an indefinite elastic force, where generated in contact with the extreme temperature of the fire-surface, permitted to expand *its* volume and proportionately to part with its specific power, till, when reduced to a moderate degree on reaching the steam-chest, it is, in this weakened state, admitted to the engine; having suffered an intermediate loss just as indisputable and to be calculated in the same way, as that incurred by Mr. Parsey's much condemned arrangement.

On a superficial view many will be disposed to think that, as all the power generated is still confined within the boiler and reserved for engine use, no loss can possibly have occurred, (just as I have heard it affirmed of Mr. Parsey's regulating cylinder,) forgetting that it is the quality or specific elasticity of the steam, and not its mere volume, or, in other words, its *relative* and not its *absolute* power, which we are to regard; and that we might just as well assert that no power was expended by the steam in the cylinder, in the process of forcing the piston from one end of it to the other, because we have all the steam still securely shut up therein.

The obvious remedy for this loss in the present boiler, its existence once recognised, is to draw off the steam for use from a point as near as practicable to its source, so as to preclude this intermedi-

* We should be glad if any gentleman who possesses sufficient information respecting the course of studies in this college, would favour us with the means of laying them before our readers.

expenditure, and to the same extent increase its *useful* power. The only method, so far as I am aware, suggested for effecting this, was described in a recent number of your Magazine, under the name of the "Hydrostatic Boiler," where a submerged collector limits the internal expansion, and conveys the steam almost directly from its source. Although I consider this arrangement to be founded on sound principles and capable of being easily reduced to practice in almost every existing form of boiler, I should be glad to see some of your intelligent correspondents give their opinion of it; as if this, or any other invention possess merit, it is a public benefit to have it recognised, but, if not, the sooner it is exploded the better, and in either case a free expression of opinion is desirable.

I am, Sir, your obedient servant,
J. M.

## THE GUTTA PERCHA PATENTS. NO. I.

[With the view of satisfying the general curiosity which prevails respecting the remarkable substance called Gutta Percha, recently introduced from the East Indies, and giving manufacturers as much insight as we can into the various,—we had almost said innumerable—uses to which it is applicable in the arts, we propose giving in succession abstracts of all the patents which have been granted in relation to it. We commence with that which, being the first, may, we presume, be considered as the master patent of the whole.]

No. I. RICHARD ARCHIBALD BROOMAN, of No. 166, Fleet-street, London. *For "Certain Improvements in the application of Fuels, Mastics, and Cements."* Being a communication from abroad. Patent dated March 11, 1845. Specification enrolled Sept. 11, 1845.

The specification commences with the following recital:—

Whereas there has been recently imported from the East Indies a natural resin, resin-like substance, or mastic, not previously known or used in the arts and manufactures of Europe, called gutta percha (sometimes gutta tuban) which has been found to possess properties that render it peculiarly adapted to the effecting of improvements in the preparation and application of artificial fuels, mastics, and cements.

*First*—It is of a highly combustible quality, being chiefly composed of carbon and hydrogen, while at the same time it inflames only at a very high degree of heat, and is not injuriously affected by any known degree of atmospheric heat.

*Second*—It is soluble in essential oils, but resists to a great extent the action of grease and unctuous oils.

*Third*—It mixes readily with paints, pigments, and most other colouring matters.

*Fourth*—It is repellent of, and unaffected by cold water or damp.

*Fifth*—It may be so softened by mere immersion in hot water, or by exposure to steam or hot air, as to be capable without further treatment, of being kneaded, or moulded, or rolled out, or pressed into any desired shape, and to any extent of tenuity.

*Sixth*—It is of a strongly adhesive or agglutinating quality, and when dry is free from stickiness.

*Seventh*—In the dry or solid state it is flexible, of great tenacity, and to a slight degree elastic.

*Eighth*—It is impermeable to, and not injuriously affected by atmospheric air.

*Ninth*—It is in a pure state nearly inodorous, and

*Tenth*—It is little, if at all, injured by use (except as a fuel,) and may, after it has been employed in a manufactured state, be recovered or renovated, and manufactured anew.

In some of these properties, namely, its adhesive, and water and air repellent properties, gutta percha resembles caoutchouc, but it is advantageously distinguished from it in its freedom from stickiness when dry, in its not being so affected by atmospheric heat, or by unctuous oils, and in its being workable by means of hot water alone.

The patentee then describes how this substance may be applied, either by itself, or in combination with other materials to the production of (1.) artificial fuels, (2.) mastics, and (3.) cements.

1. *Artificial fuels.* Five different sorts are described, the peculiarity in all of which consists in the substitution of the gutta percha, in different forms or proportions, for the coal tar or other agglutinizing substance ordinarily employed.

2. & 3. *Artificial mastics and cements.* The gutta percha is directed to be first freed from the fibrous and foreign matters with which it is usually found intermixed in the state in which it is imported, by passing it repeatedly through a cleansing or washing machine, (of which a description with drawings is given,) after which it is to be applied in any one of three states, namely,—1. a plastic state; 2. a granular or pulverized state; and 3. a state of solution.

1. *Plastic applications.* The gutta percha is first subjected to the operation of a kneading-machine (also described) similar to that used in the caoutchouc manufacture; and while passing through the machine, it may be mixed with various other modifying ingredients in manner following:—

When it is desired to give to the mass of gutta percha a greater degree of elasticity than is natural to it, I mix up and incorporate with it while it is going through the kneading-machine, either a portion of caoutchouc, or a portion of sulphur, or portions of both caoutchouc and sulphur. The following are good average proportions: about three parts of caoutchouc for every six parts of gutta percha, or one part of sulphur for every eight parts of gutta percha, or two parts of caoutchouc and one part of sulphur for every six parts of gutta percha. When caoutchouc, however, is employed to increase the elasticity of the gutta percha, a degree of heat of not less than 150° Fahrenheit is necessary to effect the amalgamation of the two substances. The caoutchouc is most conveniently introduced into the machine at the same time with the gutta percha, but the sulphur should be dropped into and upon the gutta percha from time to time, and in small quantities at a time. The gutta percha takes up the other materials readily, and the whole are, at the end of the process, thoroughly amalgamated.

Should it be desired to give any colour to the mass of gutta percha to render it the better adapted to the purposes to which it is to be applied, the requisite pigment or colouring matter is introduced in the same way as the sulphur, and also in small quantities at a time. The colour penetrates every part of the mass, and becomes perfectly amalgamated and identified with it.

The gutta percha may be also improved in smoothness by incorporating with it some pulverized French or Turkey chalk, or other soft powder, adding it in the same way as the sulphur or colours.

Or should it be desired to render it rough and abrasive, it may be mixed up with some ground emery, sand, or other hard substance in a granular state.

The patentee then gives the following exemplifications of the numerous uses to which it is applicable in the plastic state:—

By itself it may be manufactured by moulding, stamping, embossing, casting, or any other known process or processes for giving figure and form to plastic substances, into various articles of use, as glass and picture-frames, cornices, mouldings, and other architectural ornaments, panelling, mosaics, &c., buttons, studs, counters, labels, balls, &c., bracelets, armlets, garters, rings, and other circular articles, reins, bridles, belts, bands, &c. Or it may be used (when sulphurized especially) for any purpose for which an elastic air and water-proof substance, unaffected by ordinary degrees of heat, is suitable, as, for example, as a material in which to produce pictures either in relief or in intaglio; or as a covering for beds, couches, and cushions; or as a material for billiard-table cushions; or as a substitute for metallic springs; or as a bearing for railway-rails and chairs, or parts of machinery; or as a material for atmospheric-railway and other valves.

In combination with other substances or materials, the gutta percha may, in any of the plastic states aforesaid, be used either to cement them together or to render them air or water-proof. The articles of manufacture to which the gutta percha is in these states most usefully applicable, are single and double fibres of cotton, wool, and other fibrous materials; leather, and other membranous textures, table-covers, floor-cloths, goods-wrappers, tarpaulins, printers' blankets, lappings for the cylinders and bowls of printing and embossing machines, driving-bands, &c.

In all the combinations before specified, the gutta percha is superimposed upon, or interposed between surfaces, but the patentee observes:—

There are other combinations in which the gutta percha is in its plastic state intimately mixed or blended with other materials, as, for example, there may be added to the gutta percha, while in the kneading-machine, paper pulp, wood-dust, leather-dust, hair, bristles, oakum, &c., (taking care when they are not originally in a comminuted state to cut them small;) and compound fabrics will be thus produced very suitable for paving, roofing, sheathing, and other purposes.

2. *Granular applications.* The processes described under this head are particularly novel and ingenious:—

I take the gutta percha, of any of the varieties before described, that is to say, either plain, or sulphurized, or coloured, and rasp it down to a powder; I then apply it in this state to the taking of casts of busts, cornices, and other works of art, in round or curved forms, and to the producing of impressions in relief from surfaces engraved in intaglio. Or perforated through and through any given pattern. When casts of busts, &c., are to be taken, the mould is filled with the grains or powder of the gutta percha, and then heated till the gutta percha becomes reduced to a mass sufficiently ductile to be pressed into all parts of the mould.

When impressions in relief from flat surfaces, engraved or perforated as above, are to be taken, the surface is laid upon a flat table, and the powder sprinkled rather thickly over it; a straight-edge is then drawn across the surface, which causes all the sunken parts or holes to be filled up, and removes any superfluous powder from the raised parts. The surface is then subjected to a heat sufficient to soften the gutta percha, when the piece of cloth, leather, paper, or any other substance or material which may be desired to take the impression in relief, is laid upon the surface, and pressure applied to it by a roller or otherwise; the gutta percha leaves the broken parts, or holes, and attaches itself to the cloth or other substance, which then exhibits an exact copy, in very bold and durable relief, of the original subject.

3. *Applications in a state of solution.* As before stated, the gutta percha may be dissolved in most of the essential oils, and by the application of a gentle heat, but the patentee states that he prefers "using for the purpose, rectified naphtha, or rectified oil of turpentine." Of its uses in this state we have the following catalogue:—

It may be used in this state either by itself or mixed with sulphur, caoutchouc, colours, French chalk, or any other of the substances with which it has been before directed to be mixed in the plastic state for the purpose of increasing its elasticity, or giving it colour, or smoothness, or roughness. It may be also applied in a state of solution to rendering water and air proof, or to cementing the various articles to which gutta percha has been before stated to be applicable for these purposes in the plastic state, when superimposed upon, or between, the surfaces of articles.

A convenient method of forming gutta percha into sheets, is to float it in a state of solution upon plates of glass, slabs of polished slate, or any other flat and smooth surface, (using it at such a temperature that it will spread easily over the whole plate or slab,) and then leaving it to cool and dry. These plates may also have patterns or designs engraved upon them, which will be transferred to the sheets of gutta percha. In the state of solution gutta percha may be likewise applied to the better coating and protection of articles that have been previously treated with caoutchouc, either simple or sulphurized, or any other water or air repellent substance or preparation, or for the purpose of obviating the stickiness peculiar to unsulphurized caoutchouc. Further, it may be applied in this fluid state to the saturation of cordage of all sorts, in order to increase its strength, and render it waterproof, and as a size for stiffening silks, ribbons, and other fabrics. And, lastly, it may be employed in this liquid state mixed with colours for printing silk, cotton, leather, and other fabrics.

*(No. II. in our next.)*

## NOTES AND NOTICES.

*The Royal Steam Navy.*—A considerable encrease has just taken place in the pay of the engineers of this branch of the service. A first officer of this class is to have, when at sea, 160*l.* 16*s.* per annum! and the lowest 78*l.* How often must we repeat that such high pay without a corresponding advancement in rank, is likely to do more harm than good. The Steam service of our navy will never be placed on its proper footing until those who have the active direction of it have the rank as well as pay of gentlemen.

*Captain Smyth's paddle-box boats*—Somehow or other, these boats, once so generally praised and adopted, have recently fallen into disfavour with our naval authorities. The reason assigned is their great weight. The following curious illustration of the valldity of this pretext is given by the Portsmouth correspondent of the *Times*:—"When Captain Smyth's paddle-box boats were taken out of the *Retribution* on the plea of their weight and the inability of the vessel to carry them, we imagined that the woodwork with which the paddle-wheels were subsequently enclosed would have been very much lighter than the paddle-box boats of Captain Smyth's invention, but we find the wooden framework actually within half a ton of being as heavy as the boats! Their removal, therefore, has been a manifest injustice to the inventor, as well as endangering the lives of all who go in the ship, from not having at hand the proper means of saving life in the event of accident. Added to which, the removal of the *Retribution's* boats (certainly the most abominably ugly made boats ever built in modern times) has given a plea for the removal of the *Terrible's*, which has been claimed and allowed, notwithstanding the *Terrible* is of 200 tons more burden than the *Retribution!*"

*Steamers' Boats.*—The *Liverpool* steam-ship, with a fair wind, shapes her course so as to run on a rock, about seven miles from St. Finisterre. Of course no one was to blame It was not the Captain's business to know that steering a particular course would bring his ship on the rocks. The ship drifted to the shore, and it soon appeared that there was no chance of her holding together long, and that the passengers and crew must take to the boats. Then follow the disasters referable to the inadequacy and unfitness of the boats in ordinary use. The launch was swamped on the breakers, and a lady, a child, and a female servant drowned. The pinnace and a quarter boat were stove in the attempt to launch them. This is quite the routine account in such cases, the boats being unfit for the circumstances in which they are wanted—very fit boats to carry out a warp, or to go to and fro in harbour, but not of the build to hold a number of passengers and to encounter a heavy sea—not safely to be launched, and when launched, not by any means sure to swim. We have here another example of the neglect of the paddle-box boat (Captain Smyth's) on which we have so often remarked—a boat, the strength and build of which secure her against accident in launching (for which she has all suitable tackle,) and which will swim in any sea, and hold conveniently and safely as many people as the ship is likely to have on board.—*Examiner.*

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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1181.] SATURDAY, MARCH 28, 1846. [Price 3d.

Edited by J. C. Robertson, No. 166, Fleet-street.


## THE SINCLAIR INDICATOR, OR SELF-INSTRUCTING NAME-BOARD FOR THE PIANO-FORTE AND ORGAN.

Fig. 1.

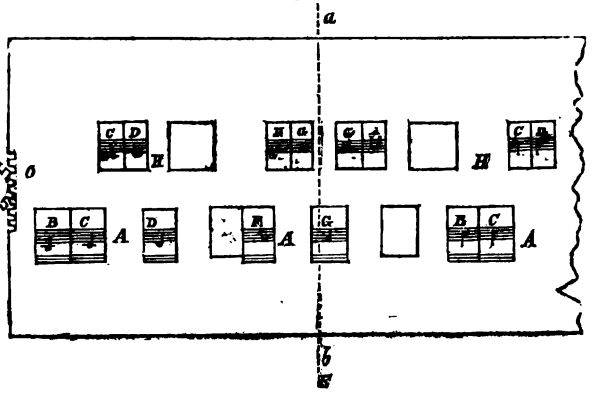


Fig. 3.

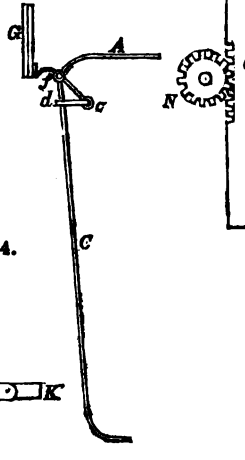


Fig. 4.

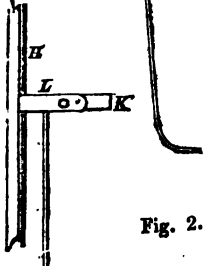


Fig. 6.

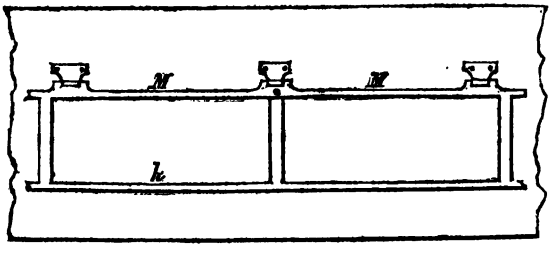


Fig. 2.

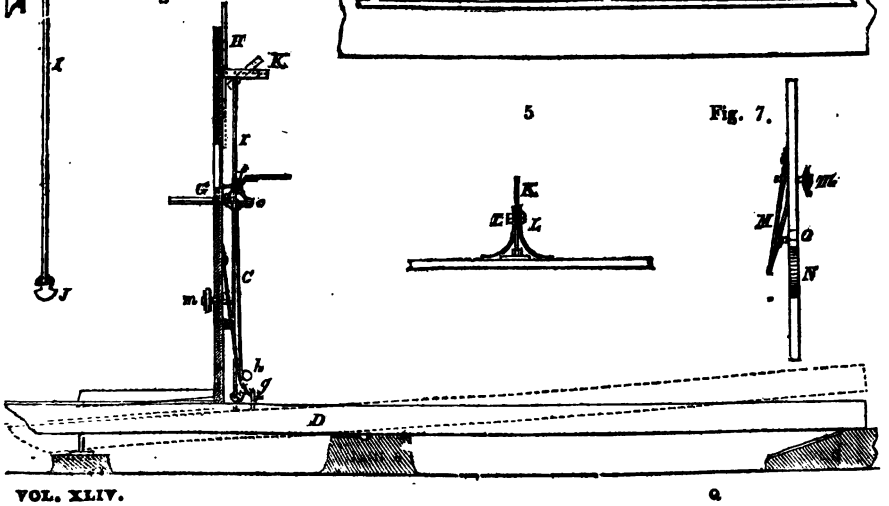


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Fig. 7.

## THE SINCLAIR INDICATOR, OR SELF-INSTRUCTING NAME-BOARD FOR THE PIANO-FORTE AND ORGAN.

[Registered under the Act for the Protection of Articles of Utility.]

THE present instrument is the invention of Mr. Sinclair, the celebrated vocalist, who though long lost to the public in that capacity, has not ceased to take a lively interest in the improvement of everything pertaining to the art of which he was so distinguished an ornament. The object of the "Sinclair Indicator" is to furnish a simple and effective method of teaching youth the notes of the piano-forte or organ; as also to enable persons who may be ignorant of music to instruct themselves in the practice of these instruments. There is great ingenuity shown in its construction, and a competent judge (which we do not ourselves pretend to be of such matters) has expressed to us a highly favourable opinion of its usefulness.

Fig. 1 is a front-view of the Indicator, and fig. 2 a section of the same on the line *a*, *b*, of fig. 1. A A, are a series of shutters which turn upon joints, *c*. Upon these turning shutters are represented the letters and notes, corresponding to the name of the key struck, and they are supported and connected to the Indicator by means of a staple, *d*. C is a wire connected to each shutter at *f*, and taking into a staple, *g*, fixed to the key D, and kept in its proper position by a spring, E, attached to the Indicator, or Name-board. G G, is another series of shutters, connected at F to the shutters A A, and placed in such a position that they shall occupy the space left vacant by the shutters, A A. The letters upon the shutters, A A, indicate the sounds produced by striking the keys, and are termed in music the natural notes. A view of one of these shutters is given separately in fig. 6. H H, are a series of slides, upon which are represented those letters and signs corresponding to the sharps and flats of music. Each slide is moved up and down by means of a wire, I, to one end of which, and resting upon the key, is attached a weight, J; the other end being connected to a lever, K, that turns upon a pin, passing through the bearings, L L. These bearings are attached to the Indicator, and of such a shape as to form a guide for the slides to move up and down in. A separate view of one of these slides is given in elevation in fig. 4, and plan, fig. 5. The dotted lines of fig. 2 indicate the position the whole apparatus assumes upon striking the key, D.

When the Indicator is not required to be used, it is raised out of gear in the manner represented in fig. 6. M is a portion of a frame, which is attached to the back of the Indicator: the lower part, *h*, of this frame is pressed against the wire *c*, by means of a pinching screw, *m*, placed in front of the Indicator, thereby throwing the wires, *c*, out of the staples, *g*. The Indicator is then raised from off the keys by means of their pinion, N, taking into the rack, O, placed at each end of the Indicator. Should it be desired to restore the Indicator to the position represented in fig. 2, it is first lowered into its position by the rack and pinion; then, by turning the screw, *m*, the reverse way, the spring, *p*, restores the frame, M, to the position represented in fig. 7; while the spring E, placed at the back of each of the wires of the shutters, A A, presses those wires through the staples, *g*, and thus renders the whole apparatus fit for action.

The Indicator may also be fixed or placed on the keys of any piano-forte or organ, and lifted on or off at pleasure.

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## LONDON FIRES IN 1845—BY MR. W. BADDELEY, C.E., INVENTOR OF THE PORTABLE CANVASS CISTERNS, IMPROVED ENGINE LAMPS, HOSE-REEL, PREVENTOR, FIRE-ENGINE SPREADER, ETC.,—(CONCLUDED FROM P. 217.)

It might almost have been supposed that the rapidity with which these awful calamities followed each other, and the excitement thereby occasioned, would have led to the immediate adoption of preventive measures of some kind or other. But, alas! they scarcely formed a nine days' wonder! In some cases a coroner's inquest sat, and returned the usual verdict of "accidental death," quite as a matter of course, without comment or remark. In the case of the Dover-

street tragedy, Sir James Graham was made the scape-goat, while the Fenchurch-street Solons handed over the odium to the "Police Committee." Had the verdict of the jury in each of these cases been "*manslaughter against themselves*," it would have been both morally and legally more correct than that to which they had so unanimously agreed.

The aristocratic and opulent parish of St. George, Hanover Square, would seem to have been unable or unwilling to make any provision for saving the lives of its numerous inhabitants, and, but for the greater humanity located in the adjoining parish, (St. James,) the list of victims in Dover-street would have been still greater than it was.

In the city—that focus of blundering and jobbing—the case was, if possible, much worse. *Fire-escapes* were abundantly numerous around the fatal spot, but it being nobody's business to fetch or apply them, nor even to know where they might be found, they were a dead letter; and with this fact staring them in the face, the jury agreed to the verdict I have recorded!

Immediately after the fatal fire in Dover-street, Colonel Wood (member for Brecon) rose in the House of Commons to inquire "if there would be any objection to lay before the house the evidence taken during the late inquiry respecting the fires that had recently taken place, in which so many lives were lost and so much property destroyed? It did really appear to him that measures for preventing the frequency of similar calamities ought to be adopted."

Sir J. Graham said, in reply, "that the evidence to which his Hon. friend referred had not yet been reported to the Home-office. As to the *police* taking precautions by means of *fire-escapes*, or otherwise to prevent danger from fire, he begged to say that that matter had some time ago been carefully considered, and was still under the consideration of his noble friend at the head of the Woods and Forests. Some time since his noble friend had taken steps to procure information as to the precautions taken on the subject of accidental fires in the United States, in Vienna, in Paris, and other parts of the world. For his own part, he entertained a very strong opinion on the subject; but as his noble friend had not yet received any reply to his inquiries, it would, he thought, be premature to enter into any discussion at the present moment. When they had sufficient information to lay before the house, it would then be the proper time to take the matter fully into consideration, and submit some measure to the house."

Whether more USEFUL information on this head might not have been obtained with greater ease and expedition *at home*, is a question that will naturally present itself to many persons. The experience of various systems by the insurance companies in *London*, the working of the combined firemen and policemen in *Liverpool*, and the separate fire-police of *Manchester*, might, one would suppose, have furnished Lord Lincoln with sufficient data whereon to found an arrangement sufficiently adapted to the exigencies of this metropolis. It is notorious that in the construction and management of all kinds of fire-extinguishing apparatus, the English have long been unrivalled, and that the best fire-engines met with in foreign countries are the production of English factories.*

It is a lamentable fact that the subject of escape from fire is one which the public generally do not understand, and have little inclination to study; and yet, only let a fatal fire occur at their door, and a knowledge of everything connected with the subject falls like the mantle of Elijah on their shoulders; and at inquests and meetings they discourse most learnedly upon the qualifications necessary for a good fire-escape, and expatiate upon the superior capabilities of some favourite scheme—the only one probably they are acquainted with out of the thousand and one contrivances proposed for this purpose. Official importance supplies the place of practical experience, and their less-informed brethren listen to their learned dogmas and high-flown panegyrics, with the attention due to the consequence with which they are propounded, and eventually, perhaps, suffer themselves to be led into the perpetration of some extraordinary absurdity.

After the *last* Fenchurch-street tragedy (for there have been three), a very pretty brass model of a fire-escape was exhibited

* Very good fire-engines on Newsham's plan are manufactured in the United States, but the Americans have not yet adopted Hadley and Simpkin's patent, now almost universally employed in this country.

at the house, and under the patronage of one of the common-council for the ward. This model was mounted on a low four-wheeled carriage, and consisted of an elegant flight of broad and easy stairs, with balusters, hand-rails, &c., terminating in a handsome and capacious balcony of a horse-shoe form, which presented itself most enticingly before the two first-floor windows of a model house. A second similar flight of stairs, with another balcony, was wound up from within the former, and offered a charming mode of descent to the second-floor sleepers; while a more modest continuation ascended to the upper story for the accommodation of "John" and "Mary." The elegant construction and exquisite finish of this model, with the convenient and safe descent which it promised to afford, was so fascinating and irresistible, that in spite of my reiterated assurances to the ward-officers of its impracticability, they stultified themselves by giving an order for one of the machines to be made for the future protection of the lucky denizens of *Langbourne!* The acknowledged weight was *eight hundred weight*, but if carried out according to the original design it would have exceeded a ton.*

Money was, however, advanced, and a machine commenced; but at every step some serious difficulty presented itself, and it was not until the expiration of several months that a "frail thing of wood and iron," of a most complicated character, had been licked into shape, but no more like the model than "Ossa to a wart." From lack of engineering skill, in attempting to keep down the weight, the machine had been so badly proportioned and arranged, that it could not be moved from the maker's yard without breaking down under its own load.

It was evident that a very grievous error had been committed, and the machine was taken to pieces, remodelled, and somewhat simplified; but, as reconstructed, is still so deficient in stability and strength, that it would be highly dangerous to transport it from its birth-place. Instead of the elegant flights of stairs with balusters, hand-rails, &c., the machine has degenerated into a set of sliding step-ladders—a clumsy imitation of Gregory's patent fire-escape; a good specimen of which, stronger, more compact, and in every respect superior to the present abortion—has been constantly used in Guildhall for the last twenty-five or thirty years.

People will act under the erroneous impression that no good fire-escape is in existence, whereas there are many good ones, if means could be adopted for ensuring their attendance when wanted. Much merriment was created at a recent parish meeting, where this subject was under discussion, by one of the speakers affirming that they wanted a SELF-ACTING *fire-escape;* upon which a gentleman present undertook, on behalf of Mr. Jerome, the celebrated American clock-manufacturer, to furnish any required number of machines the vestry might choose to order, which, "on *hearing* the cry of fire," should proceed immediately to place themselves in the proper position to rescue the parties in danger!

At a meeting of the Court of Common Council a few months since, the subject of fire-escapes was mooted, when Mr. R. Taylor said "he was convinced that the care and management of fire-escapes should be in the hands of the *police.*"

Mr. Lott very properly asked, why the fire-escapes already provided by the police committee were not in operation? No satisfactory explanation could be given of this matter; but the home thrust was attempted to be parried by Alderman T. Wood (the chairman of the police committee), who ventured an opinion that the *canvass escape*, a few of which had been provided in some of the city wards, was the only one likely to prove useful. The *canvass escape* alluded to by the alderman, is the "jumping-sheet" of the philanthropic Captain Manby, which certainly combines in a high degree the important advantages of cheapness, portability, facility of stowage and application; and it has recently been the means of saving several lives. It

* At the exhibition the following curious colloquy took place. *Mr. B.*—I hope the ward will not commit themselves by spending any money upon so impracticable an affair. *Mr. S.*—Pray, Sir, have you anything better to offer? *Mr. B.*—No, Sir; but you already have something better in your ward. *Mr. S.*—To what do you refer? *Mr. B.*—To Merryweather's portable fire-escape ladders. *Mr. S.*—Do you know what reason the keeper of them gives for not bringing them to the late fire? *Mr. B.*—I do not, but should much like to know. *Mr. S.*—Because they are so heavy it requires two or three men to carry them. *Mr. B.*—Very good; and so, because the ladders, weighing about one hundred weight, are too heavy to be useful, you propose to remedy the evil by providing a machine weighing a ton! Good day, Sir.

requires little practical acquaintance with this subject, however, to perceive the erroneous character of Alderman Wood's conclusion. Of what use would such an escape have been at Mr. Satchell's fire, even if brought? None! For in order to rescue the unfortunate sufferers, it would have been indispensable to send up assistance to the window just within-side of which they had fallen. The same remark applies to other cases, and proves beyond all question that it is a *sine qua non* in a fire-escape, to be useful, that it should afford the means of *ascent* as well as *descent*—but not after the fashion of Sancho Panza's blanket!

By turning to page 455 of your 33rd volume, your readers will have an opportunity of referring to Alderman Wood's opinions, professions, and promises respecting fire-escapes for the city, just five years ago. Up to this time not one iota of the expectations then held out have been realized.

Although an elaborate investigation had taken place, a report been brought up by the police committee, its recommendations approved by the Court of Common Council and sent back to be put in operation, and promised by the police committee to be carried out, yet up to this time the business has not advanced a single step—not even the step "EXPERIMENTAL!"

Surely this body must have come to the same conclusion as one of your recent correspondents, that the loss of life to be guarded against is "*only one a year*," and therefore really not worth providing for, or making any bother about. The calamities of the past year, however, present a sad and striking commentary on the *falsehood* as well as the *inhumanity* of this remark. It must be borne in mind, that it is not only those who have been lost, but also the still larger number who have been saved—saved with extreme difficulty—that compose the number actually to be provided for.

In exemplification of the old saying that you should go abroad to hear news, I quote the following from the *Birmingham Journal* of Feb. 14th last.

"Mr. Wivell has received an order from the *Corporation* of London for four of his fire-escapes, for the use of the *metropolis*"!!! I need hardly inform your readers that no such order has been given, or even contemplated. I believe an objection exists to making the application of fire-escapes a branch of police duty, and that is the reason why those already provided have not been made available. How much longer the public safety is to be sacrificed to individual caprice, I know not, but it is high time some better understanding should be established.

Unfortunately for the cause of humanity, and indeed for the common weal, but little encouragement is given in this country to individual merit. On every hand we hear the complaints of merit unappreciated, and efforts unrewarded. Although it may be true, that a man only follows the dictates of his own generous nature when he endangers his life to assist or save that of a fellow creature, yet the satisfaction arising from the consciousness of having performed a good action is in no way diminished by the additional gratification of some honourable tribute to his usefulness. His very disinterestedness heightens his claim to distinction and reward.

"The soldier who fights in the field of the brave," feels an honest pride in receiving and decorating himself with the outward and visible tokens of his gallantry, though that token be but a small bronze medal—intrinsically worthless. The associated remembrances of efforts made and dangers surmounted give the little medal a very high value. It is true, we have, so called, *Humane* and *Encouragement* Societies, but the inhumanity of the one, and the discouraging influences of the other, are notorious.

That "they do these things better in France," is evidenced by the following extract from a recent number of the *Moniteur*:—

"Four hundred and ninety-five medals (thirteen of *gold*, the others *silver*,) were distributed in 1845, to as many citizens, as a recompense for acts of courage, intrepidity, and noble disinterestedness; viz., 188 to a number of citizens, or public functionaries, who saved the lives of 287 persons: 114 to military men in active service, who saved 111; 99 to firemen who saved 19; 51 to custom-house officers, forest-keepers, &c., who saved 40; 25 to boatmen, who saved 101; 4 to clergymen, who saved 3; 5 to women, who saved 7; 9 to children, who saved 12. Total, 495 medals. Total of lives saved, 576. It is with a lively interest

that we find in the above returns, 4 clergymen, 5 women, and 9 children, who saved in all 22 persons. Among the females, were two young girls under 20 years of age, and several of the children had scarcely reached their tenth year."

Again, when a man by dint of great personal exertions, and some risk, succeeds in arresting the progress of an incipient conflagration, he derives but small satisfaction from the assurance that—"Virtue is its own reward."

The law of *salvage* works well in maritime concerns, and might be applied to other accidents of life with considerable advantage. We will take one from a thousand instances to illustrate our position. Some few months since a fire occurred in the extensive warehouses of Messrs. Oliver, Dear, and Co., in Aldermanbury; on that occasion the persons in their employ exerted themselves in the most heroic manner, and succeeded in arresting the progress of the fire, some of them being severely burned in the conflict. The amount of property preserved to the Insurance-offices by these exertions was very large, but the victors complain that they could obtain no adequate recompense for their well-directed efforts, and the personal sufferings endured. The consequence has been, that like the whipped school-boy, they have most faithfully promised they "will never do so again"! It is certain, also, they will keep their word. This fact was notorious, and produced its dire effect when the fire broke out in the adjoining premises of Messrs. Bradbury. It was first seen preying on some waste paper and a few empty packing cases, and much less exertion than was made by Messrs. Oliver's men would have extinguished it. Messrs. Bradbury's people seem to have thought with *Rochefoucault*, that in this case "a wise man had rather avoid an engagement than obtain a victory;" they accordingly declined to persevere in a conflict fraught with personal inconvenience and danger, and in which, even victory brought no laurels. They therefore ran off to fetch those whose *proper business* it is to extinguish fires, during which time the flames spread beyond control, entailing an enormous loss.

There may be sufficient reasons for objecting to the distribution of pecuniary rewards in such cases, but none can exist to the giving of honorary ones; and what would a few medals cost in the course of a year? A very different system however, has hitherto prevailed, every possible discountenance being given to amateur firemanship.

I have in former reports pointed out the great necessity which has existed for the judicial investigation of the causes of fire when their origin has been involved in any degree of obscurity. I last year reiterated the remark of Mr. Dudley, (from the *Tocsin*,) "that *a jury should be empanneled on every fire*," to endeavour to ascertain its origin.

During the past year this wholesome suggestion has been realised, by Mr. Payne, Coroner for the city of London, who, immediately after the fire in Aldermanbury, held a *Court of Inquiry* (in the nature of a coroner's inquest,) to ascertain the origin of the destructive fire which took place, August 18, at the premises of Messrs. Bradbury and Co. "This step taken by Mr. Payne in holding a court to inquire into the origin and circumstances of this fire," observes the Editor of the *Times*, "is one which we trust will be followed in all similar cases. In modern times it has been usual for coroners to sit only when death has ensued, but in law their jurisdiction is much more extensive. The revival of a branch of his power by Mr. Payne, after such long disuse,* may naturally induce some speculation as to its legality, which is founded on the ancient statute of King Edward I.—*De officio Coronatoris.*" The result of this inquiry was, the satisfactory elucidation of the accidental origin of the fire in question, albeit not free from the charge of great carelessness on the part of some person.

On the 10th of December, Mr. Payne again exercised his power, in consequence of a fire taking place under circumstances of more than ordinary suspicion, on the previous Sunday night, in the premises of Mr. Ford, a printer in Breeme's Buildings, Beech-street, Barbican. After a lengthened investigation, the jury returned a verdict, "that the fire was wilfully caused by George John Ford," and the coroner made out his warrant for his committal. The accused was

* It is not clear that there had ever been such *use*. Mr. Wakley denies that the Coroner has this power.—W. B.

tried at the Old Bailey at the following sessions, when the jury returned a verdict of "*not guilty.*"

More recently Mr. Bedford, the coroner for Westminister, has followed the example of Mr. Payne, in the case of wilful fire raising by a maniac. The wilful firing of premises is comparatively easy of proof, but to fix the crime upon its author is in most cases exceedingly difficult. In June last, a trial, which occupied two whole days, took place in the Court of Queen's Bench, between Firth *v.* Richter. The defendant is the respected secretary of the *Phœnix* fire-office, against whom the plaintiff brought his action for a large amount of property, said to have been destroyed by a fire, which happened at one of the plaintiff's residences in Suffolk-place, Lower-road, Islington. This fire was stated, in my annual report for that year,* to have been *wilfully* occasioned; and that fact established through the prompt attendance and judicious application of the Islington parish-engine. The villany disclosed in the course of the evidence was almost unparalleled; and at its conclusion the *plaintiff's own counsel* (Mr. Jervis) said, "If the jury should find a verdict for the defendant upon the evidence as it now stood, they must find the plaintiff guilty of arson, which might have been accompanied with the murder of several persons, including his own son. They must also find him guilty of perjury and subornation, and must be of opinion that he, his son, Mrs. Whitmee, their servant, and Dr. and Mrs. Irving, as well as others of the witnesses, must have all conspired to support the claim for the purpose of defrauding the Phœnix Insurance Company.†" The jury consulted together for about twenty minutes, after which they returned a verdict *for the defendant!*

At the close of the last year, the London fire-establishment superannuated Mr. Jonathan Crookland, who has from its commencement discharged the arduous duties of foreman, in the eastern district (A) of the metropolis. Mr. Crookland formerly belonged to the *Albion* fire-office, a select and aristocratic corps, well known among their brethren of the "Brummagems," as the "white stocking firemen." He afterwards wore the *Protector* coat, and on the formation of the fire-establishment was appointed to the foremanship as due to his qualification and experience. The harassing nature of his occupation, together with the infirmities of advancing years, have at length produced their natural consequences; and he has now retired, to spend the remainder of his days in ease, and enjoy the comforts provided by the liberality of those whom he has so long and so faithfully served.

Mr. Crookland has been succeeded by Mr. Foggo, whose zeal and attention in the foremanship of the western district (C) has well entitled him to this distinction; the urbanity of his manners will long be remembered with pleasure in the district he has left, and procure for him a similar measure of esteem in his extended sphere of usefulness. The foremanship of the G District has been awarded to Mr. George Staples, some time principal engineer at the Watling-street and Chandos-street stations.

Upon most occasions the firemen of the establishment have had the advantage of Mr. Braidwood's personal superintendence; while in his absence the several foremen have supplied his place to the utmost of their ability. The men have, upon every occasion, displayed their wonted zeal, courage, and alacrity; their exertions being generally rewarded with well-deserved success.

The *West of England* firemen, under Mr. Connorton, have in no respect fallen below their conduct in former years; on the contrary, they are ever among the foremost and the most active. The order of their arrival has frequently been astounding, and the *animus* which has directed their efforts upon all occasions, has procured for them "golden opinions" from their employers, and the esteem of all observers.

The *County* firemen, under Mr. Garwood, continue to rival those of "the other colour." Prompt in their attendance, and willing to bear their full share of all needful exertion, they have contributed their proportion to the general success, and proved most important auxiliaries in the western district of the metropolis where they are stationed.

The *police* have not on all occasions shown to equal advantage; their conduct at the fatal fires in Dover-street and Fenchurch-street was much complained of. It has been objected that, to add to

* 1842: *Vide* vol. xxxviii. p. 169.
† From the *Times* of June 30, 1845.

their present duties that of firemen would only lead to confusion; and yet how inseparable are the two branches of duty, and how inevitably they will connect themselves, is shown by Mr. Braidwood having certified to his employers that during the past year, the *police* have, in more than a hundred instances, *successfully discharged the duties of firemen*—in many cases superseding the necessity for further aid. In the police returns credit is taken for a large amount of services; but this must be partly accounted for by many of the cases not being known to the firemen, and therefore not included in their report.

The Royal Society for the Protection of Life from Fire, since it was remodelled in 1843, has been progressing in usefulness, and consequently in public favour. The society has for some time past maintained twelve stations, at regular distances, from Eaton-square, Pimlico, to St. John-street, Clerkenwell. At each station there is a fire-escape and conductor, who is provided with a crowbar, axe, and rattle; and it is the duty of each conductor to be with his machine (in the management of which he is well instructed) throughout the night, and to proceed with the same to a fire immediately on the first alarm. The report for 1845 is not yet published, but by reference to that for the former year it appears that one or more of the society's fire-escapes attended *eighty* fires, and happily saved the lives of *ten* persons, who, it is confidently believed, would have perished but for the timely aid thus offered to them.

The Society has just extended its sphere of usefulness into the city, and will, it is to be hoped, afford that protection which appears to be unattainable in any other way. The metropolis will in future be divided into two districts, east and west of St. John-street, each of these under the care of a vigilant superintendant.

On the re-modelling of the Royal Society for the Protection of Life from Fire, it was resolved, as one of its fundamental regulations, that a *Report* should annually be made to the subscribers, of the transactions of the committee, of the condition of the machinery, and an audited statement of their receipts and disbursements. By the accounts for 1844 it is shown that of the total expenditure, (which was 948*l.* 7*s.*) no less than 888*l.* 5*s.* 9*d.* was expended in the legitimate objects of the society. The *expenses*, including printing the reports, were but 55*l.* 1*s.* 8*d.* The society has now a most respectable committee of management, with a very numerous list of annual subscribers, but from the smallness of the subscriptions (from 5*s.* to 20*s.* per annum) a large increase of numbers is required to enable them to carry out the original design of the society, viz., "To provide stations, and maintain a fire-escape, attended during the night by a well-disciplined conductor, at intervals of five minutes' call from each other throughout the metropolis."

Scarcely one-fifth part of the metropolis is at present thus provided, and it remains with the public generally to determine when more shall be so.

29, Alfred-street, Islington,
February 19, 1846.

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ON NEUTRAL SERIES.

Sir,—May I intrude upon the pages of your Magazine for the purpose of bringing a few remarks under the notice of the eminent mathematician mentioned below?

I would suggest to Professor Young,* that in his late beautiful, elucidation of the nature of the limiting values of the infinitely distant terms of the fraction $\frac{1}{1+x}$, one consequence of his views seems to have escaped him.

And (1) let $x$ *decrease* to unity, then the remainder being infinite, terms of S, immediately preceding the remainder, become infinite also; so that in this case the series S is utterly different from $1-1+1-$ &c. *in inf.*

(2.) Let $x$ *increase* to unity, then the remainder being zero, terms of S immediately preceding that, remainder become zero; and there are also intermediate terms whose values are neither 1 nor 0;

* We should have felt a delicacy in the adoption of this subject from the *Philosophical Magazine*, in which the discussion was first commenced by Professor Young, had not the violent and offensive tone of Mr. Moon in the progress of it, rendered it imperative on the part of the Editors of that valuable work to discontinue all further reference to it. We are for our own parts determined that every side of every question shall have a fair chance in our pages—except when expressed in the vulgar and insolent tone, in the indulgence of which we are happy to say, Mr. Moon stands *alone*. See *Phil. Mag.*—Ed. M. M.

for instance, the $(k+1)$th term becomes $=\frac{1}{e}$ when $k=a$; and S loses all resemblance to the neutral series. It is true that the numerical value of S becomes identical with, what I imagine to be, the true and only value of the neutral series, in the same way that in the summation of series, consisting of converging and diverging terms, results are obtained by taking the converging terms only. I have the honour to be, Sir,

Yours faithfully,

JAMES COCKLE.

Devereux-court, Temple.
March 21, 1846.

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## MISCELLANEA MATHEMATICA.—IX.

(Continued from page 221.)

### *Mathematics as a Branch of Professional Study.*

The most fatal error which can be committed by a young professional student, is, that any one kind of knowledge can be acquired without close and systematic application. If, too, there be one class which is less capable of being so acquired than another, it is the mathematical. The length of time which a suitable professional course will require is quite another matter: but we must insist, as a primary condition, upon close and systematic study during the time that the subject requires. For those alone who are prepared to fulfil this condition do we offer our suggestions; and we should much regret if in any way we shall be found to have contributed to the formation of that most disgusting of professional characters — a compound of half-learning, self-conceit, and supercilious dogmatism.

We hear so much every day respecting *taste* and *genius* — especially that mathematics inevitably tend to destroy the one and repress the other—that we cannot too earnestly warn the professional student against the influence of this kind of ignorant *cant*. Taste and genius are not familiar terms in the vocabulary of those few men who really possess them. Such men know too well how they cultivated the faculties which they possess, to feel justified in urging any young man to trust to his rude natural powers, however high their order may be. Why, we would ask, should the taste be depraved by a knowledge of the conditions within which the laws of nature *compel* all structures and machines to be limited? What is the use of fancies which can never be realised in construction? What is the value of those imagined forms which can only look well on *paper*? Possibly, however, the outcry against science will be in the main confined to those "exhibitors" and "candidates" whose highest ambition is to figure as the designers of something extravagantly original; and who have not the most distant expectation of being employed to build according to their own designs. It is strange to what expedients men will resort for "obtaining a name;" and few modes are more common, we may say more vulgar, than to make a dash at reputation for taste and genius! Let such persons ponder well the following remark on the latter subject from one of the ablest men of our time,—Professor Young, of Belfast.*

"The great object of education is to originate an earnest desire after knowledge, and to foster the habit of private and solitary study. Without such a habit intellectual eminence can never be attained. It is in this that the true secret of what is called *genius* consists —a name that only serves to conceal from us the continuous effort—the untiring perseverance, and the days and nights of solitary labour, to which the attainment of excellence is always due."

Algebra and geometry, as sciences, are almost alike repulsive to the unpractised mind upon the first glance; although that repulsiveness in the two cases does not arise from precisely the same cause.

In algebra, the chief difficulty is that of attaching general ideas to general symbols, whilst those symbols have already acquired different, and altogether dissimilar meaning in our estimation. There certainly is, when we carefully analyse the operations of our own minds, a very natural difficulty in attaching the idea of "*any* number" to a symbol, which in all our previous acquirements has been solely viewed as the visual representative, or symbol of *sound*. Yet it is, in fact, an effort of the mind not greater to conceive a number represented by a visual symbol, than a sound represented by it,

* Three Lectures on some of the Advantages of Mathematical Study. Souter and Law, 1846.

or a thing represented by a sound. All the real difficulty arises from the previous appropriation of the symbol as that of a sound. Yet, on the other hand, numbers are familiarly represented by peculiar symbols in the ordinary notation, and even by letters in the Greek, Roman, and other languages. The difficulty, then, will be probably transferred to the expression by means of a letter of any *arbitrary* number, so that in one research a letter may represent 5, in another 999, and in fact any number we please.

It may assist the young algebraist to be impressed, *in initio*, with the conviction that algebra is but an application of the *rules* of arithmetical operation to these symbols of number taken as of *any actual values* whatever:—that the symbols $+$, $-$, $\times$, $\div$, $\surd$, *etc.* designate *directions to perform* certain operations which they represent, according to the definitions given of them:—that in all, or in nearly all cases, the algebraic solution ends with a *direction to perform* the indicated arithmetical operations, when the specific numbers of a given problem are substituted for the literal symbols: and that, in fact, the literal symbols are only abbreviated expressions of the terms "first number," "second number," *etc.*, of any given arithmetical rule which applies to those numbers from the relations given in the particular question itself. To take a single instance, let us suppose a question in "the rule of three" proposed, which, when stated according to rule was,

$$3 : 6 :: 9 : \text{answer.}$$

Then the rule itself for finding the answer is,

$$\text{answer} = \frac{6 \times 9}{3} = 18.$$

Suppose now, that instead of the *given* numbers 3, 6, 9, we had the general literal symbols, $a$, $b$, $c$ of any numbers whatever, and that $x$ be put for the present unknown answer; then it would stand

$$a : b :: c : x, \text{ or}$$

$$x = \frac{bc}{a}.$$

In this case, the value of $x$ can only be expressed in the form of indicated operations, and its *actual value* will depend upon those of $a$, $b$, $c$. This, then, is clearly, only a symbolical expression of the *rule* for finding the fourth term of a proportion, from having given the actual values of the first three.

It is not, however, our object to write an elementary treatise on algebra, and we have only referred to it to point out what we conceive to be the real cause of the early repugnance of students to algebraic practice; and by showing its origin, to prove by how easy considerations it may be removed. We may further specially recommend to every young student the tract of Professor De Morgan, on *Algebraic Equations*, published by the Society for the Diffusion of Useful Knowledge. It is, in fact, a little work from which mathematical teachers themselves may derive much "useful knowledge;" and to the private student, it will prove of the greatest advantage, in clearing up those elementary difficulties, which, by so often occurring, much retard his progress and diminish the pleasure and satisfaction of the study itself. He will, with this aid, very soon acquire a facility in the transformations, and a clearness in comprehending the force of the symbols of the ordinary algebra. In conjunction with this, the student may read in the algebra of Professor Young, the "*Introduction* to the Elements of Algebra" by Mr. Hind, of Cambridge, or the Algebra in the 12th edition of "Hutton's Course." In the last-mentioned work there are several improvements in different operations, and in some parts of it a closer approximation traced between arithmetical and algebraical processes than we have noticed elsewhere: at the same time, we feel sorry to say, that we consider the editor not to have made the full use of his views of which they are capable. There is room for much improvement in this part of the work. May we hope for their full development in a future edition?

With respect to algebraic problems, they are usually taken much more from combinations of general commercial transactions, or the affairs of common life, than from amongst the technical examples of the uses to which algebra may be professionally applied. Writers on elementary science have less in view to serve the demands of particular classes, than to supply the wants of the general teacher. No publication, we should think, would undertake the risk attendant on an alge-

braic work, professedly and exclusively designed for the use of engineers and architects; although, doubtless, such a work may be composed by many mathematicians now living, had they adequate encouragement to proceed. Still, all such examples as furnish exercise in the formation of equations expressive of given conditions, and the subsequent resolution of those equations, *do* answer a useful purpose—that of creating algebraic skill and power. One advantage, on the other hand, of a professional algebra, would be the fixing in the mind from their frequent occurrence certain *constants* that occur in the practice of these sister arts; whilst another would be, that greater facility of investigation in problems of the professional class would be given, than can be acquired by imaginary problems of merchandise, horses, wine, or dogs. We should think, indeed, that a course having a more direct professional bearing in this respect would be a desideratum with the Professors of the College for Civil Engineers; and but for our knowledge of its former mismanagement, we should have certainly looked to it to furnish a model of such a "Course" as seems to be naturally expected to emanate from a college instituted with such special objects as this is. We conceive, that whilst it would be thus conferring a boon on the profession, it would be materially serving its own pecuniary advantage, and still more materially contributing to its own reputation. We would earnestly direct the attention of its Principal to this subject.

It will be utterly useless for the student to proceed to the ulterior applications even to professional purposes, till he has acquired a *complete mastery* over the practice of the ordinary rules of operation and transformation. This is his first stage—which we consider to terminate with the resolution of quadratic equations—and which, once passed, algebra will cease to offer other than the most ordinary difficulties.

Many subjects are discussed in our elementary works, upon which we would advise the professional student to bestow but little attention in the earlier stages of his reading; and in fact, not at all, till he finds that his pursuits make some demand upon them. They can be easily acquired if found necessary; and till they are found so, all attention to them will retard his progress towards other topics which are most essential to him. Such, for instance, as continued fractions, progressions, quadratic surds, infinite series, the properties of numbers, etc.

We would, however, strenuously urge the clear understanding and facile employment of the doctrine of intermediate co-efficients as an object of the greatest importance. It is one of the most powerful instruments of research that we possess; and may, indeed, be considered the key of the higher mathematics. It immediately introduces us to the most simple proofs of the binomial theorem, the exponential theorem, the doctrine of logarithms, the expansion of trigonometrical functions, and even of the differential calculus. In point of fact, there is nothing to prevent our *immediately* entering upon the study of this last subject, when the use of indeterminate co-efficients is once rendered familiar to us, except it be that some other of the subjects which are usually made to intervene in a mathematical course are also of greater importance to be studied early. Upon this, however, more hereafter.

We can never too urgently warn the professional student to beware of a captious spirit, and of cavilling with metaphysics of the algebraic system. What he cannot now see in this respect, he will understand hereafter, if he will steadily pursue the route through which he is led. Let him avoid the discussions which he may stumble upon, respecting symbolical and arithmetical algebra, the interpretations which some ingenious persons have put upon $\sqrt{-1}$, apart from its being the expression of impossibility; and twenty others which may come before him. His business is with the ordinary processes of algebra, and with valid reasons for their adoption; and as a professional student, he has no other business with the subject, whatever, as a mere lover of speculation he might have had. On the other hand, we are far from recommending his acquiring a lax habit of reasoning, or taking any rule that may be propounded without reasonable and satisfactory evidence. As a habit it will be the most pernicious, the most fatal he could contract. It would, indeed, be scarcely better than the "rule of thumb" practice that has done, and still does, almost invariably constitute science amongst engineers and architects.

Having made these general remarks upon the study of elementary algebra, we shall in our next Number proceed to suggest some considerations relative to geometry; after which algebra and geometry in combination will receive due consideration.

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THE COLLEGE FOR CIVIL ENGINEERS.

Sir,—In No. 1180 of the *Mechanic's Magazine*, page 220, there are some strictures on the school at Putney, originally (and for all I know, though if so, very improperly,) designated as the College for Civil Engineers. Having been the first appointed Resident Director to the college, though I ceased having any connection with it full two months before it opened, I am desirous of correcting a most erroneous statement in your said article. The College for Civil Engineers, you or your correspondent states, was formed on *joint-stock* principles. Now, Sir, this is absolutely false in any other sense than that there was the collective efforts of several individuals in endeavouring to establish an institution such as was then, and is still, most urgently called for. A line or two further it is designated as a mere *commercial speculation*. Now, Sir, whatever may have been the case subsequently, I beg most distinctly to say, that not only was the college *not* a commercial speculation, so long as I had anything to do with it, but that the condition on which I consented to be in any way connected with it, was precisely that the institution should have no such character with regard to the appointment of a *Military Governor*, and the introduction of *Military Regulations*. I neither pretend to know, nor judge of what was done by others; but I assert that so long as my views were entertained, there was nothing military in the system but uniformity of costume, and that degree of discipline and order, of which the due observance, so far from "creating a spirit of reckless dissipation that rendered the establishment a scandal and a nuisance to the district in which it was located," would have rendered it the pride of its locality, and a model for all similar places of instruction.

You say very truly, "a good deal of curious matter is connected with the history of this institution." As far as I am concerned, nothing would give me greater pleasure than to see such a history of it, if true and impartial, made public. Whether my own views were right or wrong I shall not now stop to argue; but as no single one of the promises held out to the public by the *prospectus* issued in my time has been kept by those who directed matters after I ceased to have anything to do with the college, so it is most unfair by anything said, or left unsaid, when speaking of the college, to include me directly or by inference in any censure passed upon the establishment. From what I learn it is now as good a school as most of those we possess; but it has not a single feature of the institution which I hoped to see established for the benefit of the public and glory of the country.

I am, Sir, your most obedient,
J. R. JACKSON.

March 23, 1845.

*Note.*

"Party is the madness of the many for the gain of the few," said one who knew experimentally the composition of parties of almost every kind. Our work, however, was not established as a party work for party purposes; and so far from shutting our pages against the explanations of those who have felt themselves aggrieved by either our own or our correspondents' remarks, "Fair play and no favour" has been the guiding principle of our editorial life. It has now and then happened to us, as we believe it has to the conductors of periodical literature in general, to so express ourselves as to call for reply; and though the apparent cause has been a misunderstanding of our drift, we have not on that account deemed it "fair play" to exclude the rejoinders of those who imagine themselves to be aggrieved, so long as they express themselves in the temperate and courteous manner that Colonel Jackson has done in the letter which bears his signature. That letter, however, contains passages which we consider should not be allowed to appear in our pages without one or two remarks from ourselves.

In the first place, Colonel Jackson denies that the constitution of the college was on the "joint-stock principle." There must

be some misunderstanding as to terms here. We will ask the gallant Colonel to state whether it was not composed of a certain number of partners or proprietors, who each paid down a certain sum of money, or at least subscribed for a certain number of shares? Were not these gentlemen entitled to advantages greater than were offered to the public generally, by the power of nomination of students on terms *far below* what the value of the sum subscribed rendered equitable as between themselves and the public? These are matters which we believe to belong to Colonel Jackson's own period of connection with the college, and which admit of an easy answer. If such were the case, we cannot see wherein the original constitution of that college differed from that of other joint-stock schools —or, in fashionable parlance, "proprietary schools." Was there not, too, a "committee of management?" And did not the committee-men each get paid for their formal half-hour's weekly attendance at the institution by a guinea, their travelling expenses, and a weekly dinner? If we are wrong we are open to conviction; but something like this, we are informed, was the practice.

Of course we do not presume to dictate to any commercial committee the steps it should take in order to best effect its objects. If the public choose to support an institution so conducted, it is no business of ours to interfere. The lieges of our Sovereign Lady "have a right to do as they will with their own." But to say that the college was not formed on the "joint-stock principle"—nay, more, for Colonel Jackson to state that the condition on which he "consented to be in any way connected with it, was precisely that the institution should have no such character" — does appear to us to require a totally reversed definition of the term "joint-stock" from the ordinary one.

We certainly raised no question as to the *precise periods* at which any regulation was adopted, or at which any officer of the institution was appointed or removed. As, therefore, Colonel Jackson's "connection with the institution ceased full two months before it was opened," we cannot really see upon what ground *he*, at least, can feel himself to be reflected on in our remarks. We must say, too, that the implications of censure upon his successors, which the general tone, as well as special phrases of his letter appear calculated to convey, would have come with a better grace from another pen than his.

The College of Civil Engineers was certainly not the main object of our article, and was only alluded to because it stood as an incident in our discussion. What we did say, referred to the twofold consideration, first, the principle of its constitution, and the confessedly unsuccessful operations of its committee and professors for several years; and, second, the fact that before its objects could be efficiently attained, the management was obliged to be concentrated in one individual. He would not, we apprehend, be an ordinary character who could redeem the moral and intellectual chaos which he found at Putney, into a respectable, orderly, and studious body of young men.

It is not for us to discuss with Colonel Jackson the *beau ideal* of an educational course. That it is different from that of the present principal of the college, he takes care to tell us; but whether it is one better adapted to the purpose we cannot decide. One thing we know, that military officers are not in general more likely to understand the art of tuition, than men whose lives have been wholly devoted either to learning or to teaching. Military men are only accustomed to mere *routine*, and this, if we mistake not, is the most fatal habit that either a teacher or a governor can acquire. At all events, the results of military management in the College of Civil Engineers are not calculated to inspire confidence in such appointments. It is now gone out of fashion to think that the *cat-o'-nine-tail* principle in training young men for their civil and social duties, is conducive either "to the benefit of the public" or "the glory of the country."—Ed. M. M.

THE GUTTA PERCHA PATENTS. NO. II.

RICHARD ARCHIBALD BROOMAN, for "*A thread made from a substance not hitherto applied to that purpose, and also the application of it to the manufacture of piece goods, ribbons, paper, and other articles.*" (A Communication.) Patent dated March 27, 1845; Specification enrolled, September 27, 1846.

The invention comprehended under this patent is stated to have for its object the "manufacture of a thread of great strength and durability, and perfectly water-proof," from the substance called Gutta Percha, and "the application thereof to the manufacture of piece goods, ribbon, paper, and other articles." The specification then describes the manner in which this object is carried out.

I take a lump or roll of the gutta percha after it has been cleansed, kneaded, and reduced to a plastic state by the means described in the specification of certain other letters patent for England granted to me, of date the 11th March, 1845, for "certain improvements in the preparation and application of artificial fuels, mastics, and cements," and either coloured or not coloured, sulphurised or not sulphurised, and manufacture it into threads of any required shape and degree of fineness, by subjecting it to the operation of a machine such as that of which a sectional elevation and plan are given in figs. 1 and 2 of the drawings annexed.

The machine referred to is very simple. It consists of a die-box kept hot by steam, from the bottom of which a number of small tubes project downwards into a tank filled with cold water; and a cylinder and piston mounted on the top of that box. The mode of operation is as follows:—

The piston is withdrawn from the cylinder, and a roll of the prepared gutta percha introduced into the cylinder immediately above the die-box. The piston is then replaced, and forced steadily downwards by hand or other suitable power upon the gutta percha, which, becoming softened at the lower end by contact with the hot die-box, escapes from the pressure through the tubes in a series of threads, which, as they drop into and are cooled by the water in the tank, are carried round a roller, whence they are conducted to and wound upon a set of revolving reels mounted in suitable bearings at the opposite end of the tank. Care is taken that the pressure on the piston shall be uniform, and kept up uninterruptedly until the whole of the roll of gutta percha is exhausted. The threads, in being wound on the reels, are only slightly stretched, but from these reels they are afterwards transferred to a second set of reels, and in the act of reeling are stretched out by hand (after the manner of hand-spinning, that is, by working the thread between the fingers and thumb) to about four times their original length. The threads are then wound off on bobbins, and ready for use.

Or, instead of the preceding process the following may be adopted.

I take the gutta percha in the sheet state, as prepared according to the directions given in the specification of my before-mentioned letters patent, dated the 11th March, 1845, and either coloured or uncoloured, sulphurised or not sulphurised, and cut it into strips and threads by means of revolving circular knives, according to any of the well-known modes followed in the cutting of bottle or sheet caoutchouc into threads. But as, by this last-mentioned process, flat or square threads only can be produced, if it be desired to give a round form to these flat or square threads, I attach each thread by one end to a whirl such as is used in rope-making, and making the other end fast to a hook fixed in any convenient situation, cause the thread to revolve at a rapid rate on its own axis, whereby, after a short time, it becomes sufficiently rounded. Or I twist and spin two or more such flat threads together into one round thread, by means of a bobbin and fly-frame such as is used in the cotton manufacture. Besides giving to the gutta percha threads the desired roundness, these whirling and twisting processes have the effect of greatly improving them in point of elasticity.

The following details are then given as to the application of the thread so manufactured to different purposes.

The thread of any of the varieties aforesaid may be applied to the manufacture of piece goods (meaning thereby all such as are made in broad and long continuous pieces, whether by weaving, framework-knitting, or netting,) either by itself or in combination with threads of silk, cotton, flax, wool, or any other fibrous material or materials; and such combination may be either by covering or sheathing the gutta percha thread with silk, cotton, flax, wool, or other fibrous material, as is done in the manufacture of caoutchouc elastic bands by means of braiding machines. When the gutta percha thread is used by itself, it will be found more particularly applicable to textures which it is desirable to render proof against wet and damp.

A strong and perfectly waterproof fabric is formed by simply laying a number of gutta percha threads side by side upon a foundation of cotton, or linen, or other textile fabric, and passing the two materials between heated rollers, which has the effect of cementing the threads firmly to the cloth and to one another; and such fabrics may, by using threads of different sizes and colours, have every variety of striped appearance given to them.

An article resembling diaper, or mosaic work, is made of gutta percha threads of different colours or shades, very rapidly and economically, in manner following:—The gutta percha threads are laid in rows one above the other, in the order of juxta-position and super-position required by the pattern determined on, and each row cemented to that beneath it by a solution of gutta percha, or any other suitable cement. When a mass or block of sufficient magnitude has been thus built up, it is cut transversely into sheets of any required thickness, by means of a vibratory cutting machine similar to that commonly used in the cutting of caoutchouc blocks into sheets.

In the manufacture of ribbons, and other narrow goods, gutta percha will be found valuable, both in the naked and sheathed states before described, as a substitute or partial substitute for the organzine silk usually employed for the warp of such articles, especially galloons, doubles, and ferrets used for bindings, bands, straps, &c.

A paper very difficult to rend, and which will, therefore, be found extremely suitable for documents exposed to much tear and wear, as bills of exchange, share certificates, &c., and also for wrappers and envelopes of all sorts, is formed by interposing between two sheets of paper pulp threads of gutta percha, laid crosswise, like net-work, at distances of an inch or two (more or less) apart, and combining the two sheets of pulp by means of the machine for which Mr. John Dickinson, of Nash Mill, obtained letters patent for England, of date the 17th Oct., 1839, or of any other suitable machinery.

The gutta percha thread may be also plaited, either in the naked or sheathed states, into hats, caps, and bonnets, or into bags, baskets, and basket-work, or into coverings for chairs (as a substitute for cane), or into whips, bridles, and reins, or into any other similar articles.

And finally, cordage of great strength may be made by twining together threads of gutta percha with threads of flax, or other durable fibrous material, by the same processes as are ordinarily followed in the manufacture of the different sorts of cordage.

## LIST OF ENGLISH PATENTS GRANTED BETWEEN FEBRUARY 25, AND MARCH 25, 1846.

John Samuel Templeton, of Sussex-place, Kensington, artist, for improvements in propelling carriages on railways; and improvements in propelling vessels. February 27; six months.

Peter Armand Lecomte de Fontainmoreau, of New Broad-street, London, for a new mode of manufacturing and glazing cotton wadding, and its application to the making of mattresses. (Being a communication.) February 28; six months.

James Soutter, of Limehouse, engineer, for an improved pump, applicable to steam-engines, or other purposes. March 2; six months.

John Fuller, of Beacham-well, Norfolk, farmer, for improvements in apparatus for sowing corn or other seed. March 5; six months.

William Nicholson, of Manchester, Lancaster, engineer, and George Wardsworth, of Sutton glass-works, in the same county, manager, for certain improvements in the manufacture of glass and other vitreous products. March 5; six months.

Robert Lewis Jones, of Chester railway, agent, for improvements in reducing charcoal and other similar matters, to powder, and in treating the same when in the state of powder, so as to render them suitable to be used in place of vegetable black-drop, black, lamp-black, and other matters. March 5; six months.

Robert Warrington, of Apothecaries'-hall, London, chemist, for improvements in preserving animal and vegetable substances. March 5; six months.

William Green, of Hyde, Cheshire, baker, and Mark Walker, of the same place, grocer, for certain improved apparatus for facilitating the putting on of boots to the feet. March 11; six months.

Godfrey Woone, of Kensington, Middlesex, gent., for certain improvements in the art of engraving in relief. March 11; six months.

Jean Joseph Ernest Barruel, of No. 172, Rue St. Jacques, Paris, chemist, for improvements in working of certain sulphurets to transform them into metal or oxides, and to collect the latter; also to collect the oxides from oxidized ores, equivalent to these sulphurets. March 11; six months.

William Nairne, of Millhaugh, Perth, North Britain, flax-spinner, for a new mode, or new modes of propelling carriages along railways. March 11; six months.

Parfait Grout, of Rouen, France, but now residing at Leicester-street, Leicester-square, doctor of medicine, for improvements in the manufacture of plaster-of-paris, lamp-black, and coke. (Being a communication.) March 11; six months.

Frederick Crace Calvert, Paris, for improvements in the preparation of the article called "Jute," rendering the same suitable for various useful purposes. March 11; six months.

William Price Struve, Swansea, civil engineer, for improvements in ventilating mines. March 11; six months.

Erastus B. Bigelow, Boston, Massachusetts, for certain new and useful improvements in looms for weaving certain kinds of carpets, or other fabrics of like character. March 11; six months.

George Hinton Bovill, Millwall, and Robert Griffith, Havre, France, engineers, for improvements in apparatus applicable to the working of atmospheric and other railways, canals and mines, and in improvements in transmitting gas for the purpose of lighting railways and other places. March 11; six months.

Benjamin Shaw, Bradford, York, overlooker, for improvements in preparing for spinning worsted and other yarns. March 11; six months.

Thomas Vaux, Frederick-street, Gray's-inn-road, Middlesex, land-surveyor, for improvements in the manufacture of horse-shoes, and horse-shoe nails. March 11; six months.

Charles Robert Robinson, Strines, Derby, calico-printer, and William Bowden, of the same place,

mechanic, for certain improvements in machinery for washing and cleansing cotton, linen, or woollen fabrics. March 11; six months.

John Benfield, Birmingham, Warwick, organ-builder, for certain improvements in making signals and communications on railways, and between railway-engines, carriages, and trains, which are also applicable to other localities. March 11; six months.

Henry Austin, 10, Walbrook, London, civil engineer, and Joseph Quick, Summer-street, Southwark, Surrey, engineer, for improvements in the construction of railways, railway-carriages, and conveyances. March 11; six months.

Thomas Hancock, Stoke Newington, Middlesex, esquire, for improvements in the manufacturing and treating of articles made of caoutchouc, either alone, or in combination with other substances, and in the means used or employed in their manufacture. March 18; six months.

John Longbottom, of Edward-street, Leeds, mechanist, for improvements in the manufacture of oil-cake, and in the machinery and processes for pressing and moulding the same; which machinery and processes are also applicable to the manufacturing of other articles from plastic materials. March 18; six months.

Bennett Woodcroft, of Manchester, printer, an extension of letters patent for the term of six years from the 22nd day of March, 1846, being the expiration of the first term of fourteen years for his invention of certain improvements in the construction and adaptation of a revolving spiral paddle for propelling boats and other vessels on water. March 21; six years.

John Haskins Gandell and John Brunton, of Birkenhead, Cheshire, civil engineers, for an improvement in the construction of, and in the mode of opening and closing of moveable bridges or arches for the purpose of carrying railways, tramways, or other roads across canals, locks, docks, or other open cuttings.. March 25; two months.

Charles Robert Robinson, of Strines, Derby, calico printer, for certain improvements in machinery for tiering, in the printing of calicoes and other fabrics. March 25; six months.

Charles Iles, of Bordesley, Birmingham, machinist, for an improvement in the method of carding certain descriptions of dress fastenings, and other articles, and in the fabrics employed for that purpose. March 25; six months.

Thomas Howard, of the King and Queen Iron Works, Rotherhithe, engineer, for improvements in steam-engine condensers. March 25; six months.

Robert Warington, of South Lambeth, Surrey, gentleman, for improvements in the operation of tanning. March 25; six months.

Thomas John M'Sweny, of Killarney, gentleman, for improvements in steering ships and other vessels. March 25; six months.

George Fergusson Wilson, of Belmont, Vauxhall, George Gwynne, of Chester Terrace, Regent's Park, gentlemen, James Pillans Wilson, of Belmont, aforesaid, gentleman, and John Jackson, of South Ville, Wandsworth, gentleman, for improvements in producing light, and in materials and apparatus applicable thereto; and in treating fatty and oily matters. March 25; six months.

Alexander Parkes, of Birmingham, artist, for improvements in the preparation of certain vegetable and animal substances, and in certain combinations of the same substances alone, or with other matters. March 25; six months.

Thomas Pope, of Kidbrooke, Kent, gentleman, for improvements in apparatus for moving railway carriages on to railways, and in machinery for lifting and moving heavy bodies. (Being a communication.) Six months.

Louis Serbat, of Saint Soulve, in the department of the Nord, in France, chemist, for a new method of constructing the roofs of houses, buildings, sheds, and all other erections. March 25; six months.

William Unsworth, of Derby, silk manufacturer, for certain improvements in looms for weaving. March 25; six months.

Charles Smith, of Newcastle-street, Strand, Middlesex, for improvements in cooking and culinary utensils, and methods of heating and suspending, or fastening articles of domestic use, and similar purposes. March 25; six months.

Joseph Needham Tayler, of Chelsea, captain in the navy, for certain improvements in propelling vessels; and also certain improvements in constructing vessels, so as to be used in combination with certain machinery or apparatus for moving sand-banks and other obstructions to navigation, part or parts of which machinery or apparatus may be used on railways, or may be adapted and applied to carriage or common roads. March 25; six months.

Edward Crump Dell, of Highgate, Middlesex, surgeon, for certain improvements in apparatus for lighting the magazines and other parts of ships; applicable also for the general purposes of lighting buildings, roads, or ways. March 25; six months.

Edwin Cotterill, of Birmingham, manufacturer, for certain improvements in articles applied to windows, doors, and shutters, part of which has been communicated to him by a certain foreigner residing abroad. March 25; six months.

William Carpenter, of Bridge-street, Banbury, Oxford, watchmaker, for certain improvements in threshing-machines. March 25; six months.

## LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65.

| Date of Registration. | No. in the Register. | Proprietors' Names. | Address. | Subject of Design. |
|---|---|---|---|---|
| Feb. 25 | 656 | William Field. ..... | Oxford-street, veterinary surgeon..... | Universal safety horse-shoe. |
| 26 | 657 | Robert Stedall ..... | Nelson-street, Greenwich, ironmonger..... | The Eolian chimney guard. |
| 27 | 658 | John & Robert Mallet | The Victoria Foundry, Dublin .. | Railway screw bolt and nut. |
| 28 | 659 | John Braddock Walmsley Maple..... | Cheshire, cotton spinner..... | Can or receptacle for roving & other perparations of cotton |
| ,, | 660 | Thresher and Glenny.. | 152, Strand, outfitters..... | Travelling case. |
| ,, | 661 | Thomas and George Barnes..... | Goswell-street, Middlesex, brace makers ..... | The flexible razor strop. |
| ,, | 662 | William Ford..... | Brixton, Surrey, coach proprietor | The omnibus ventilator. |
| March 4 | 663 | Nathan Defries ..... | 26, Grafton-street, Fitzroy-square | Gasometer induction apparatus. |

(*Continuation of this List in our next.*)

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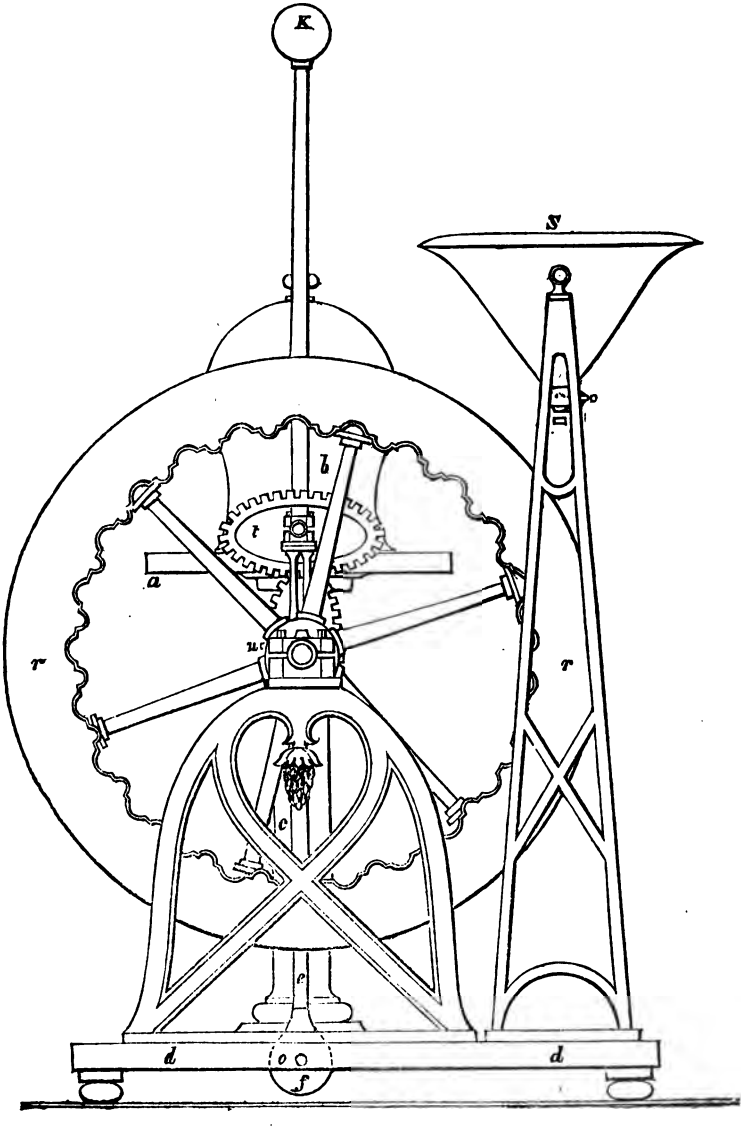
## MERCURIAL EXHAUSTER.

Fig. 1.



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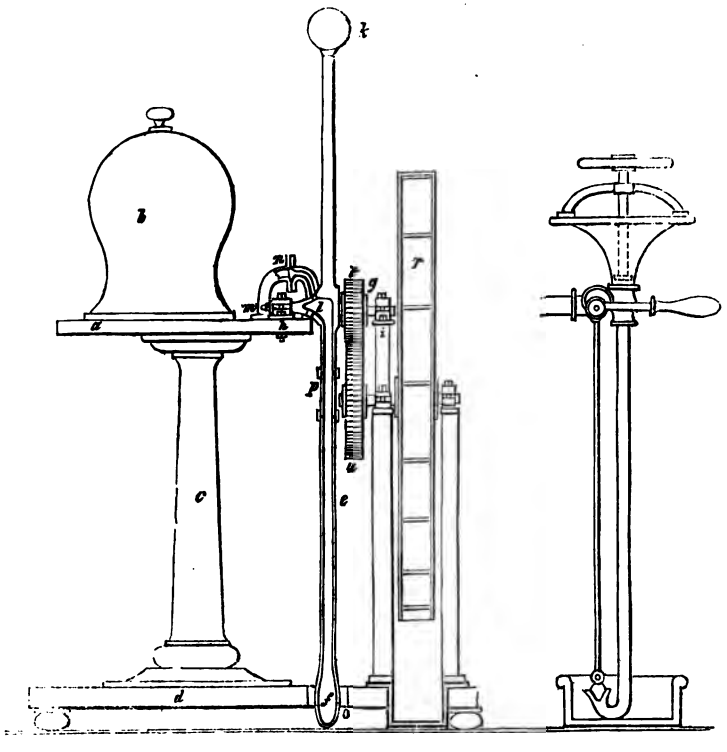


Fig. 2.

Fig. 3.

Sir,—A vacuum being required for several hours together for some experiments, I beg to submit to the consideration of your readers the following plan which I devised for that purpose, as it is well known that the common air-pump cannot be so accurately fitted as not to allow a little air to pass into the receiver when left for a length of time.

Fig. 1 is a front view, and fig. 2 a cross section of the machine; *a*, a brass slab, ground on the top side for the receiver *b*, and supported by the pillar *c*, fixed in the stand *d*; *e*, is a hollow tube three feet long, filled with mercury, having a bulb, *f*, at the extremity of it, which turns round on the spindle, *g*, working in the bearings, *h* and *i*; *l*, is a cone joint, kept tight by the nut, *m*; *k*, a weighted lever to balance the tube.

The action is as follows:—When the tube is turned downwards, as shown in the figures, nearly all the mercury descends into the bulb, and the air in the receiver passing through the valve, *n*, into the top of the tube, becomes a little rarified; the tube is then turned upwards, the valve, *n*, closes, and the mercury now runs towards the centre, the air escaping through the opening, *o*; the tube is thus alternately moved downwards and upwards until the level of the mercury, which may be seen through a piece of glass, *p*, let into the tube, coincides with the barometer. To turn the tube up and down for a length of time, and thus keep up the vacuum, many simple plans might be adopted; as a belt from a smoke-jack, a descending weight regulated by a fly or pendulum, &c. A small wheel is shown in the drawing to be turned by sand; *r*, is the wheel supplied with sand from the funnel, *s*; *t* and *u*, two oval wheels for the purpose of keeping the tube longer

in the perpendicular than in the horizontal positions.

The above principle may also be applied to a fixed tube, as shown in fig. 3; the valve, *a*, being screwed tight down to its face, the handle, *b*, is lifted up, which turns the tap, *c*, and raises the plug, *d*. The mercury now descends, as in the above plan; the tap and plug are then shut, and the tube is again filled with mercury from the funnel. If the mercury were allowed to pass the tap, *c*, and fill the receiver, a vacuum might be obtained at once; but it would require about £180 worth of mercury for a receiver of the ordinary size.

A very cheap air-pump might be constructed on the above plan by using a tap instead of the valve, *n*, and making the joint, *l*, of some elastic substance, so as to bend instead of turning.

Your obedient servant,

T. B.

Rotherham,
March 10th, 1846.

## THE SEPTENARY SYSTEM, AGAIN!

And so, Mr. Editor, after being for a quarter of a century led to believe that Mr. Jopling had discovered a method of generating almost every variety of curvilinear figure, it turns out, by his own confession, that he has been all this while urging upon us a system, of the very mode of testing which he is profoundly ignorant! He has told us that his curves are such-and-such, on the faith of a mere random guess; and he is indignant at the "mean jealousies of the profession," and the obtuseness of the public intellect, because we could not see with his eyes, and measure his merit by his own exalted standard! You, Sir, have (with more of good nature than of editorial scruple) allowed him the use of your Magazine to disport himself with his wildest fancies. At any rate, he has had fair play, and as far as I know, had it all to himself: so that if anything could be brought out of his system, it must be his own fault that it has not been done. It is time that demonstration should replace mere assertion; and that the characters of the curves themselves should be rigorously subjected to unerring tests.

Such a test I proposed,—and the only one that *can be satisfactory*. Mr. Jopling replies by referring to matters altogether irrelevant; and he puts me aside by classing me in the "Maclaurin-school," as though that were in itself a proof of my being incapable of understanding Mr. Jopling. Perhaps in one way it may be: for to be of Maclaurin's school, is to to be at least acquainted with the *elements* of algebra and geometry—the reverse of which Mr. Jopling appears to consider as a *merit* in himself. "Had I been a mathematician," he says, "in all probability the Septenary System would never have been invented." Of one thing I am sure, that had he been a mathematician, the Septenary System would never have been vaunted as it has, nor have been propounded as a wonderful discovery. It is time, I say, that this kind of empiricism should be brought to an end, by showing what the curves are, and pointing out the extent of Mr. Jopling's originality and accuracy. If you will afford me space in your Magazine* I pledge myself in a reasonable time, to investigate the nature and character of any curve that Mr. Jopling may select from any one of his systems. I must, however, for very obvious reasons, decline the proposed interview; as I should not like to have my name "hawked about" in connection with such a "piece of fudge" in the way that Mr. Jopling employs the names of those gentlemen with whom he comes in contact. Besides, the present is not a question of *mere authority, but of demonstration:* and my name could neither augment nor diminish one iota of the actual evidence which Mr. Jopling or myself may bring to bear on this question. Mathematicians own no *authority* but demonstration; they ask none else.

I do not propose in this letter to enter upon any special discussion of the curves themselves, as there are sundry little "heaps of rubbish" to be cleared away at the outset.

In the first place, *authorities*. I will venture to affirm (and Mr. Jopling is placed upon fair ground in this for disproof) that no mathematician who has

* We shall be happy to give up a number or two of the *Miscellanea Mathematica* to the use of "Centurion," if he will undertake to unravel the mathematics *implied* in the Septenary System. We have, as "Centurion" remarks, given Mr. Jopling "every chance;" and we shall not regret having done so, if what *in initio* appeared to us an ingenious invention, shall ultimately be fully and fairly settled *on its own merits*.—ED. M. M.

recommended this method of description of curves, has ever taken the trouble personally to investigate their properties. There are four names prefixed to Mr. Jopling's two pamphlets on the "Double Cranks," which ought to have some weight—Dr. Gregory, Professors Christie and Barlow, and Mr. Peter Nicholson. The first and last have terminated their sublunary career, but the other two still live, and can answer for themselves. Mr. Aikin and Mr. Tredgold are no authority at all, as their mathematical acquirements did not entitle them to form a judgment; notwithstanding Mr. Jopling's allegation of the latter having "compared it to the discovery of the cipher in arithmetic"—meaning, if we could consider Tredgold capable of a *double entendre*, that Mr. Jopling's discovery is the *cipher in geometry*. It rests with Mr. J. to offer any evidence that those four gentlemen had professedly entered further into the subject than having witnessed the operation of the instrument, thinking it produced "pretty curves," and taking the inventor's own word for the nature and properties of them.

Nor is the conversation between Mr. Babbage and Mr. Davies Gilbert more to the purpose, as narrated by Mr. Jopling. It is not, indeed, very clear what he means by such a phrase as this, "Both curves and apparatus were considered new, and *their* different methods of investigation of some of them, new to each other." Are we really to understand that these gentlemen possessed the *power of investigating* a curve, or several curves, in a public *séance* of the Astronomical Society, and comparing their results for the edification of the meeting? Every mathematician knows that in respect of curves like these, the statement is *perfectly absurd*. Why does not Mr. Jopling apply to Mr. Babbage for a certificate on the subject? Why did he not do so to Mr. Gilbert?

Again, "the five gentlemen from the Navy Board, who were with me as many days, and who came to the conclusion that what they had seen '*might lead* to the development of *principles* in *some way useful* to the naval architect.'" The names of these *savans* ought to be memorialised at the mast-head of every vessel in the service of the crown; that is, if the report of their "conclusions" be correctly stated. There is this fact, at any rate, in favour of Mr. Jopling's accuracy; that our naval architects have a singularly crude notion of what constitutes *a principle* in science; and that their entire practice is so empirical, as never to bring them into contact with one single scientific principle. In the estimation of scientific men, the primary quality of a ship is not its "line of beauty," nor any such toy of the fancy; but a form adapting it to rapid sailing, with ample stowage, with ease of motion under adverse circumstances, strength and complete subjection to the control of her helm. How are these to be determined? Most well-informed persons would say "from the principles of hydrodynamics;" but these five naval constructors, after five days' study under Mr. Jopling, come to the "conclusion" that it is to be found by means of this gentleman's tracer-bar and cranks! Wonderful prescience, indeed!

Only think, Mr. Editor, of "a Committee of the House of Commons" sitting in grave deliberation upon the characters of at least a hundred thousand* different specimens of curves! Did the Committee report to the House? and what was their "conclusion" respecting Mr. Jopling's invention?

Of the lecture of Professor Cockerell I have nothing particular to remark, except indeed to cordially concur in his opinion respecting the necessity for a more extensive theoretical, as well as "a more extensive practical knowledge of mathematical curves." Will Mr. Jopling, however, state the *relevancy* of Mr. Penrose's "determination;" or of Professor Cockerell's "four centred arches," to the subject now before us?

It creates a smile to find Mr. Jopling naïvely asking, "Is Centurion aware" of what Sir Isaac Newton has said upon the organic description of curves? I may in my turn ask him whether he is aware of the occasion on which Newton made the remark, and the purpose he had in view?

* Of the first order of lines there is one only, the straight line: the second has three varieties, besides the circle viewed as a variety of the ellipse, and the point as a variety of the circle: of the third order there are about one hundred, as determined by Newton, Stone, and others: of the fourth order, upwards (according to Euler) of four thousand distinct varieties. It cannot, therefore, be an extravagant estimation to place the number of varieties in a curve of the eighth order at 100,000.

If, as his form of quotation seems to imply, he is not aware of this, he had better refer to the *Arithmetica Universalis*. He will there find that Newton's object was the graphic solution of equations by intersecting curves referred to the same co-ordinate axes; and that his *desideratum* was not the mere general description of curves, but of curves having certain simple forms of equation. For this purpose, no curves could be *less adapted* than those of the Septenary System. Mr. Jopling has therefore not supplied Newton's desideratum. Quotations such as these, in fact, can only have the effect of throwing dust in the eyes of your readers—perhaps this may be his mode of *educating the eye* and rendering *it* "a good mathematician."

In the second place, we have to ascertain what the word "investigate" means in the vocabulary of Mr. Jopling. This, and terms of kindred import in mathematics, are plentifully sprinkled about in his writings; and I will confess that they had their weight with me when I wrote my former letter. I was led to think that he had so far employed the ordinary methods of investigation as to ascertain to what class his curves did really belong. I had, indeed, heard the contrary, but I could scarcely credit it: Mr. Jopling has, however, removed all doubts on this head, by his asserting the superiority of a visual proof over a mathematical one. It now appears that he considers "investigation" to mean *a visual comparison of the mere forms of the curves* traced by an instrument; and that "the *specimens* of curves which have been buried so long at the Royal Societies of London and Edinburgh, the Institution of Civil Engineers, the Society of Arts, &c., and which are among the finest specimens he ever produced," constitute the *investigation* of his method, and the proofs of its value. If Mr. Jopling considers this to be "investigation"—well, be it so: but he is not entitled to use a term, which amongst all educated persons means a very different thing, in a sense so remote from that in which it is generally understood. It is at the best, reducing pure mathematical evidence to a level with that of experimental philosophy—than which no two comparable things can be more dissimilar—it seems that there is no more accounting for judgment than for taste.

In the third place, and finally, it becomes necessary to point out to Mr. Jopling, in an enquiry like the present, what are the functions of mathematics.

I had proposed that he should give the *equations* of his curves, in order to our testing what those curves were, and ascertaining thereby whether they were the specific curves which he had represented them to be. I proposed the *equation* as affording a simpler and, so to say, more commodious criterion than could be furnished by geometrical considerations. He replies, that a criterion of this kind is not "any more essential to the understanding of the Septenary System than it is for a person to know the equation of a circle or an ellipsis, in order to know the different methods by which they may be drawn or described, or to know and judge of their forms by sight." With the *sight-judgment* I have nothing to do: but will Mr. Jopling seriously affirm, that if he were told that a certain "regulated motion" produced an ellipse or a circle, he would believe it upon the mere faith of the narrator, or even upon the evidence of his visual organs, educated or "taught" as *his* must be? Would he not require some proof that the point *necessarily* described the alleged curve? To get at this proof he must enter upon a mathematical investigation, (in the sense that mathematicians understand it,) either by algebra or geometry. I readily admit, that if a geometrical demonstration can be given, that the locus of a moving point subjected to conditions is a specified curve, it is quite as satisfactory as the equation would be: but this is not the question—it is, whether we are to admit the conclusion without any proof whatever besides mere visible similarity. I leave Mr. Jopling to his choice of means, but I have a right to demand a valid proof of some kind.

Mr. Jopling in saying that "equations do not give the *distinct notion* of any curves, which is produced on contemplating these lines when they have been drawn by a correct instrument," says what is no doubt true, of mere "notions." It will probably be greater news to Mr. Jopling than to any other reader of this letter, that the equations of curves enable us to trace not only their general features, but their specialities, with greater certainty than even his "taught" eye could trace them from his

drawings. I would recommend Mr. Jopling seriously to undertake the study of some elementary work on *analytical geometry*. He will then see how this is to be done, and that he might have spared both myself and others the loss of much of the time which we have squandered in our attempts to get at his meaning, and to prove what it was incumbent on him to prove for us, as the self-lauded inventor of a "new system" of generating curves.

It seems necessary to inform Mr. Jopling that there must be physical properties as well as visual ones consulted in every building; and that the physical properties of the structure are paramount considerations to those of mere ornament. Mr. Jopling, had he been concerned in works of magnitude and importance, would soon have discovered that *fancy curves*, however correctly drawn, or however graceful they appear in a picture, are seldom those which the architect or engineer can introduce with advantage, or even with *safety* into his designs. For ornamental work it is another question; a china-mug, a scent-bottle, or the pattern of a lady's spring dress, are applications proper enough for Mr. Jopling's curves.

One word more. The builder of St. Paul's was previously the professor of geometry in Gresham College.

I am, Sir, your obedient servant,

CENTURION.

Home, March 23, 1846.

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THE COLLEGE OF CIVIL ENGINEERS.—REPLY OF COLONEL JACKSON.

Sir,—I have to request your acceptance of my thanks for your ready insertion of my letter on the 23rd ult. in your Magazine. Could I have foreseen that it would have rendered necessary any further explanations, I should probably never have written it; not that I have the slightest reason to shrink from the most searching investigation of any of my proceedings in connection with the College of Civil Engineers, but because it is most unpleasant to have to speak of oneself, and because to enter fully into all the merits of the case would require a volume, whereas the space that can be allotted to the subject in your columns must necessarily be very limited. I will, however, in as few words as possible, reply to your remarks.

The establishment of the College presents three distinct phases. The first was a mere project, and had, I grant, a most mercenary character; independent of its being altogether impracticable. The plan was sent to me with a request that I would become a member of the Board of Management. To this I replied by a letter (dated May 29, 1838,) much too long for insertion here, but in which the following passage occurred, alluding to the disposal of anticipated profits: "To what purpose are these funds to be applied? If as a premium or profit to shareholders, the Institution loses all its dignity, and dwindles down to a vile, mercenary speculation clothed under a specious mask; a concern to which no man of honour would lend his name." To this letter I got no reply for upwards of two months, when I received a modified prospectus, and a letter; to this I also replied, and in this reply (dated August 15, 1838) was the following: "The organization of the establishment, and the means of raising the necessary funds seem to be attended with great difficulty, for very few, perhaps, will be disposed to advance money from principles of pure benevolence, without hope of profit; and if pecuniary benefits are held out, the thinking part of the community will see nothing in the establishment but a pecuniary speculation, reflecting, like a thousand others, little credit on those engaged in it, and destined, like most of them, to ultimate failure. The thing should bear disinterestedness on the very face of it. It must be conceived in the large and truly patriotic spirit of an establishment intended to supply an important desideratum, and confer a great and lasting benefit on the country." From these extracts, I trust, Sir, you will be disposed to believe my assertion, that the condition on which I consented ultimately to be connected with the College was, that it should not have the character of a mercenary, or joint-stock speculation. All this time I did not know, even by name, any of the original projectors. Subsequently to these letters, I, upon special invitation, met the parties, and explained to them my views respecting an institution for the supply of that scientific education to our young engineers, which they so much

wanted. My suggestions were approved, and the original idea completely abandoned.

Now came the second phase, during which, for eighteen months, I laboured night and day to organise the system of the College, and I must do the original projectors the justice to say that, whatever might have been their first intentions, they certainly, while I was with them, set aside all interested views to devote themselves to a higher and more noble object than lucre. As time wore on, incidental expenses increased, and as there was reason for believing that the one individual who had undertaken the sole responsibility of their liquidation, was not in a condition to satisfy any sudden demand without inconvenience, it was resolved that each should pay down a sum of money to secure solvency; for which sum, and for his risk, he was to receive a *quid pro quo* in the event of the ultimate success of the undertaking: but so far was this from anything like a joint-stock concern, that the published prospectus formally announced, that "whatever profits may accrue will revert to the Institution to increase its efficiency and extend its usefulness;" and farther, that "Annual Meetings of the Parents and Guardians of the Pupils should be held, at which the balance-sheet of receipts and disbursements should be produced," in order to convince them of the good faith and disinterestedness of the founders of the College. There was, of course, a Committee of Management, but their labours, in which the noble patron of the establishment often took a most active part, so far from being confined to "half-hourly weekly meetings," were often daily, and the business almost always occupied many hours. It was this absolute engrossment of time, so valuable to many, that, after some months, occasioned a proposition for remuneration. I do not pretend to judge of the conduct of others in this particular; as for myself, my time was my own, and I gave it willingly, nay, zealously, to what I conceived a national object, refusing all remuneration. I was to be Resident Director with a salary, to commence from the opening of the College. The salary was fixed by others: I agreed to it, and subsequently to a curtailment of it. With regard to "travelling expenses," I never heard of any; and as for a "weekly dinner," there was not one single dinner during the eighteen months that I worked with the managers. When, after much labour, some shape had been given to the plan and the prospectus issued, I found myself opposed in what I deemed essential to its success,* and accordingly withdrew from the concern. I had spent some little money in running backwards and forwards almost daily for many months, and in making the first contribution to the incipient library of the Institution. I had devoted my best energies to what I considered a good work, I had contributed to obtain some of the highest and most efficient patronage for the College, and I left it when I saw I could no longer exercise what I conscientiously believed a beneficial influence.

On my resignation began the third phase, of which I know also literally nothing but from report, having studiously refrained from ever seeing any of the parties or going near the place.

It remains for me to reply to your observations, that "Military men are accustomed only to *routine*," and that "the cat-o'-nine-tail principle is gone out of fashion." The first of these observations is too general; not only are there many military men highly qualified for *superintending* education, but in a great many respects they are, of all men, the best qualified for the task; and if reports are true, the administration in the hands of a clergyman was not remarkable for success. We hold that the director of such an establishment as the College for Civil Engineers, should *not* be himself a teacher. As to the *cat-o'-nine-tail* principle, it was a regulation of the College that it should not be disgraced by corporal punishments; indeed, the most liberal and gentlemanly proceedings towards the pupils were to be blended with that necessary discipline of which the students themselves are ever the first to appreciate the benefits.

One word more, Sir, and I have done.

* The point on which I split with the managers was precisely that on which you announce so just an opinion. I maintained that the management should be concentrated in the Resident-director alone; that he should be vested with authority and made responsible for its proper exercise—the council having control over the expenditure and appointments, the admission of pupils, &c. This authority was denied me; and foreseeing, to use a vulgar adage, that "too many cooks would spoil the broth," I resigned. And it was, I firmly believe, to continual interference with my successor, that much of his want of success may be fairly attributed.

It is exactly because you did not state "*precise periods*" that I could not consider myself involved in your general strictures. You accuse me of implying censure upon my successors. I distinctly repudiate any intention of doing so. It is not with the Resident-director or principals, that I presume to find fault, but with the general direction which has not kept faith with the public. The merits of the College for Civil Engineers, as projected in my time, have never been tested, as not one of the promises held out to the public has been performed—not a single provision of the proposed system acted upon. Nevertheless, my intention is not to accuse any one, but to exculpate myself. Though personally, I may have reason to be dissatisfied with those whose conduct led to my secession, I boldly assert, that so long as I had any connection with the College for Civil Engineers (and of what happened subsequently, I am not competent to speak) the plan laid down for the College, and the principles which actuated its managers and patrons were highly honourable, disinterested, and such as merited a very different result from that which, from causes I must not now go into, has attended their efforts. My ideas respecting engineering education were published at some length in No. 9, of the *Surveyor, Engineer, and Architect's Journal*, (October, 1844,) to which I beg to refer those who take an interest in the subject, and I think they will find them strictly practical rather than a mere "*beau ideal*." With many excuses for thus trespassing upon your valuable pages,

I remain, Sir, yours, &c.,

J. R. JACKSON.

March 3, 1846.

P. S.—Allow me to point out an error of punctuation in my former letter as printed in your Magazine, and which alters the sense of what I intended to say.

Line 20 from the bottom, there should be a full stop after the word "character;" the word "with" begins another sentence; and after the word "regulations" there should be a comma only.

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MR. WATT, AND THE DISCOVERY OF WORKING STEAM EXPANSIVELY.

Sir,—I did not meet with "Pressure not Puff's" letter until the 8th instant, and I wished to refer to several writers on the steam-engine, previous to any further remarks on the difference of our views respecting the character of Watt's publication of expansion before 1782.

Admitting at once the statement of the expansion of steam to the extent of one-third of the stroke in Watt's earlier water-work engines, I should feel obliged for further information as to whether Boulton and Watt ever made and sold any pumping-engines from the Soho-factory, in which expansion was not employed, at least during one-third of the stroke.

I have questioned the knowledge by the public of the fact at that time, and consider that these engines were sold under the patents of 1769, and under such conditions that the value and nature of their expansive action remained concealed from the public, owing to their ignorance of the properties of steam, and Boulton and Watt's silence on this subject.

I have always considered the expansion patent of 1782 as an admission that no previous publication had been made by Watt; and, further, that the failure of engines professedly working expansively under this patent, arose from the circumstance that the best portion of expansion had been already used under the earlier patent for separate condensation, by which means the standard of work done had been already raised higher than due to separate condensation alone. These views do not seem to be quite consistent with a legal publication of expansion to an unconscious public; but however small the difference may be to Watt's fame, the distinction is of more importance to Hornblower.

These remarks have been, it should be remembered, occasioned by my fellow-correspondent's date of "1782," as being that of Watt's expansion of steam.

The highly coloured statements of several writers, and omissions of others, are apt to produce an impression of the weakness of the case; perhaps more than the facts themselves fairly considered would justify.

Can any explanation be afforded of the suppression of Tredgold's views respecting the publication of Watt's expansion in Weale's recent edition of this work on the steam-engine? The words

marked in *italics* are to be found only in the original edition of 1827 :—

"This principle (expansion) is said to have been adopted in an engine at Soho-manufactory, and some others in 1776, and in 1778 at Shadwell water-works; *but it was not made public till the above patent was obtained in* 1782. Whereas the same principle had been made known the *preceding year* by Hornblower, though applied in a different manner; *and of two discoverers of the same principle, that one should have the merit who first makes it known to the public; for inventions are rarely withheld except through interested motives; and when a secret is kept for an individual's benefit, all claim to priority of invention ceases.*"

I remain, yours obediently,
S. S.

March 28, 1846.

P. S.—Feeling an interest in Watt's engines with only two valves, I should deem myself under an obligation to "Pressure not Puff" if he could acquaint me with the position of the condensing-valve, whether it was placed on the top or bottom of the equilibrium-pipe? And at what part of the return-stroke it was closed? These queries of course refer to what Mr. Josiah Parkes has termed the cushion of steam saved on the return-stroke of the single engine. I have heard that some of Watt's early mining engines were constructed with two valves only.

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ON THE COMBINATION OF STEAM AND CANVASS POWER IN STEAM VESSELS.

Sir,—I send you a few remarks upon a paper in the *Mechanics' Magazine*, No. 1164, page 307, by Lieutenant Ward of the U. S. Navy, upon the construction of steam vessels—an article which seems to be an attempt to prove the universal superiority of the screw over the paddle-wheel in sea-going steamers under canvass. He says, "If the wind e on the side, sails heel the vessel, bury he lee-wheel and lift the weather one; nder which circumstances both act dislvantageously and produce less speed, or rtainly no more than would result from ls alone, or from steam alone." That is sometimes the case I agree with t. In the trial of the *Royal Yacht* the *Rattler*, as stated in another part of your valuable publication, the former gained upon the latter in proportion as she shortened sail; but then, is she not well-known to be a very crank vessel? Last summer I was crossing from Ramsgate to Calais in a small vessel of 50-horse power with a very strong side-wind, and her speed on setting her canvass was augmented nearly a knot an hour. I must not omit to mention, there was a very heavy sea at the time.

Mr. Ward then proceeds to say, "The case before the wind might not be much, if any better." In answer to this, I have only to say, that during an autumn, winter and spring's residence in Edinburgh, I observed that the *Monarch*, in fine weather, generally performed her voyages in about 47½ hours, when her steam was for the most part unaided by canvass. The distance is about 474 miles, which gives a mean rate of 10 miles per hour. Her engines are 200-horses power, and her tonnage, I think, 875. But her commander always said, "Give her canvass and she is a match for any steamer out of the Forth," and as a proof, on one occasion she ran *thirty-eight* hours, or at the rate of 12½ miles per hour, which was said to be her usual speed under sail.

To this case, I must add, that of the *City of Hamburgh*, in the London and Newcastle trade. Under steam she is considered a slow vessel, on account of her small steam-power, but with her sails I am informed by good authority that she is a match for the Hull steamers, *Vivid* and *Waterwitch*, both considered fast vessels. But I will not trespass upon your space with any more of these facts, which I think tend to show that the reasoning, "That a ship may go equally well with sails alone, with steam alone, or with both in conjunction," is anything but conclusive.

I remain, your obedient servant,
No. Bigot.

March 16, 1845.

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ON THE DIRECTION OF THE MAGNETIC FORCES AS OPERATING ON THE PROPOSED MAGNETO-ATMOSPHERIC RAILWAY.

Sir,—In answer to the queries of Mr. Bursill in his communication to your Journal, on the subject of the Magneto-Atmospheric Railway, I beg to observe that there is every reason to be-

lieve, from the researches hitherto made, that the magnetic influence is communicated in right lines, radiating in all directions from the source whence it originates, and that an intervening substance, such as the sides of the basin in the case he refers to, would not cause any divergence from this course.

This question may be roughly tested by a simple modification of the experiment he refers to. If instead of filling the basin with water, and floating the needle on the surface, the needle be placed in a basin without water, and a magnet sufficiently strong to sustain the needle through the substance of the basin be held outside, it will be found that as the magnet is moved about, the needle inside will follow it. Now, it is quite evident in this case, where the magnetic attraction is sufficiently strong to entirely overcome that of gravitation, that if the former were deflected along the surface of the basin and over its edge, as your correspondent supposes probable, then the needle in following the direction of the overpowering force would rise up the inner surface of the basin, over its edge, and down the outer surface, to reach the magnet.

It appears that Mr. Bursill has been led to conceive the probability of the magnetic influence passing along the surfaces of solid bodies rather than through their substance, from the difficulty of conceiving the possibility of a *fluid* passing through such compact solids; for when he refers to this latter mode of explaining the phenomenon, he invariably speaks of the magnetic *fluid* passing through the *pores* of the vessel.

I am aware that it is the custom even of some of the most distinguished philosophers of the present day habitually to speak of the electric fluid, the magnetic fluid, the nervous fluid, caloric, &c., as though the existence of such fluids had been proved, and all the phenomena connected with these subjects were necessarily dependent upon their operation.

Now it is unquestionably the case, that we possess no direct evidence whatever of the existence of any such fluids; and the only analogical evidence that can be brought to bear upon the subject, tends, as far as it can be legitimately applied, to lead to a contrary conclusion; for sound and light, concerning the nature of which we have some amount of positive knowledge, are now pretty well proved to be, not substantial existences, but states of certain media.

In treating the subject in an elementary form, it may be sometimes advantageous to assume, as a mere supposition, the existence of a material fluid, in order to assist the mind in forming a clearer conception of the nature of certain phenomena—such as the electric spark, &c., —but this should always be done with the greatest possible caution, in order to prevent the student from mistaking this mere assumption for an elementary fact.

With all due deference to the high authorities, who have written such treatises and discourses, I cannot help believing that this caution has been in the great majority of instances very much neglected, and consequently very mistaken notions are current on the subject. We find now, that everybody, from infant prodigies up to intellectual old ladies, speaks of the electric fluid with the same confidence and familiarity as of brandy and water; and seems to believe that it can be weighed and measured with equal facility. If we analyze the popular ideas upon this subject, I think it will be found that most persons who only catch superficially at the terms and definitions of popular lecturers, &c., consider lightning, for example, to be an overflow of this fluid from the clouds, and that it is a mysterious sort of a something, very similar to quicksilver.

I do not of course assert that this error exists in so gross a form in the minds of those who have studied the subject with any degree of care; but, nevertheless, it is continually the case even with those who have made considerable advancement in it, that this notion of the existence of an actual fluid is involved in all their speculations to such an extent, as to lead frequently to very erroneous conclusions, and throw great difficulty in the way of understanding properly the nature of many phenomena that would otherwise be sufficiently intelligible. Many of the extravagant and untenable theories that have been put forward, even by men of high scientific reputation, may be traced to the undue prevalence of this idea.

I therefore venture to suggest that instead of using the terms electric fluid, magnetic fluid, &c., we should always

speak of the electric or magnetic agency or influence, as this would completely prevent any misconception on the subject; for whether subsequent discoveries should prove that electricity, or magnetism, be a fluid, or the undulations of an ether, or a polarity of the atoms of matter, or anything else, we are still perfectly correct in calling it an influence, capable of transmission according to certain laws, and of producing certain effects by its operation.

Thus in the instance before us, there will be little difficulty in understanding that the magnet attracts the needle *directly through* the substance of the basin; or the proposed iron plug through the metallic tube of the atmospheric railway, if instead of the magnetic *fluid passing*, we speak of the magnetic *influence* being *communicated* through the intervening space; for such communication can be conceived to take place with equal facility, whether the matter occupying such space be in a gaseous, liquid, or solid form.

While upon the subject, it may be as well to refer to an important difficulty in connexion with this system of magnetic traction, which, from what I have seen of the plans and propositions for carrying out the idea, appears to have been overlooked.

Most persons who have experimented to any extent with electro or permanent magnets, must have observed that the keeper attached to a magnet, which resists a very great force when exerted perpendicularly to the face of the magnet, may be moved very easily if the force be applied in a direction parallel with this face. I am not aware of the exact ratio of these forces, but have observed in the case of a magnet sufficiently strong to bear the weight of a man's body hanging perpendicularly from the keeper, without its detachment, that it may be slid off horizontally by a very slight effort, equivalent merely to a few pounds.

If I am rightly informed respecting this project, it is proposed that there shall be a horse-shoe electro-magnet attached to a carriage, and suspended vertically above the atmospheric tube, while inside the tube, attached to the piston, is an iron plug or keeper; as this moves forward, the magnet and carriage are to follow it by force of its attraction, and thus the longitudinal opening and its valves will be dispensed with.

From what I have just now stated, it is evident that the main force of a magnet thus placed will operate vertically, and its tendency, therefore, will be to pull the carriage to which it is attached downward, thus coinciding with the force of gravitation; so that if we have a magnet exerting a vertical attractive force of one ton, it will be so far just equivalent to placing one ton of additional weight upon the carriage, while the useful tractive force—that acting horizontally—will be very slight in proportion to this.

It must, however, be borne in mind that this difference between the vertical and horizontal force of attraction exerted by the magnet, most probably depends upon the same laws which determine the difference between the tangential and radial forces of gravitation, or any other force which acts equally in every direction from a central point. If this be the case, then the amount of the horizontal force will continue increasing until the tangent is equal to radius, and it will then diminish according to the law of its variation with the distance.

I should expect from this that a horizontal position for the magnet will be found better than the vertical, or it would be better still, if the magnet were so constructed as to embrace the tube, having its north pole on one side and south pole on the other, with the faces vertical, and their centres coinciding with the extended diameters of the tube, and soft iron plug or keeper.

This arrangement if fully carried out, appears to me the best which the circumstances of the case will admit of.

All these points must of course be tested by careful experiment. Mere speculation, although it cannot decide any of them until the data upon which it is founded are made certain and exact, may still be very useful in determining the most advantageous direction in which experiments should be made.

Yours respectfully,
WILLIAM WILLIAMS.

1, Francis-street, Regent-square,
March 17, 1846.

P. S.—In my communication on "Parsey's Compressed Air-engine," (No. 1179) there is an omission between the 19th and 20th lines from the bottom of the

first column of page 202. Instead of "fifteen times these forces minus fifteen," it should be, "fifteen times the *ratio of* these forces minus fifteen."

### A NEW METAL.

There is a natural feeling of pleasure in communicating to others the first tidings of any new invention which is likely to be useful, without waiting till all the particulars can be learnt. What I have now to inform you of is a new metal, which promises to be of very extensive use. The invention is that of a gentleman well versed in chemistry, who discovered it, I believe, in making some other experiments. As it is being patented, the nature of its composition is not yet divulged, but I have been favoured with a sight of the opinions of three first-rate judges on its capabilities, which I will briefly state:—It is an alloy, not malleable—not more brittle than cast steel, which, in appearance, it much resembles, and may be used for nearly all the same purposes, as well as many others. It is fusible at a much lower temperature, and is so hard as to mark glass, and the hardest steel. It is very close in the grain, and takes the very highest polish, which is a peculiar feature of it. It takes the finest cutting edge, and is very highly sonorous. With these properties it is obviously applicable to an immense number of things, among which may be stated all cutting tools, and, from the very high polish, to specula—to making bells of superior tone and size—and ornamental casting. Add to this, that its cost will be about half that of steel. I fear it will be thought that this is one of the too common over-statements of expected capabilities, but from the position of the inventor, and those from whose opinions I have quoted, it may be expected to stand the tests to which it will be shortly put, when the patents are completed.

FORESTER.

March 12, 1846.

### AN ATTEMPT AT PERPETUAL MOTION.

The account of an attempt to realise this idea, though a failure, may not be wholly uninteresting, as not only may experience be gained even from errors, but also trouble saved to others in enabling them to avoid them. Suppose then that the buoyancy in water of a flat piece of wood, when its surface lies either horizontal or more or less so, is greater than that of a similar piece when perpendicular. Connect two thin floats of wood by a slip of wood turning on a centre; the floats joined to the connecting strip by hinges, so that the one descends on one side edgeways, but the other in its rise doubling up inwards against the connecting strip draws down the other below its own level; at which point the power appears to be gained. Now, more floats added, equal on both sides, it might be supposed that they would draw one another round the extreme lowest point, and thus a continual rotary motion be produced; the same thing becoming alternately the greater and less power. Such, however, on experiment, proves not to be the fact.

AMATEUR.

### INUTILITY OF ANTI-FRICTION WHEELS FOR RAILWAY PURPOSES.

Sir,—I have carefully perused the well-intentioned endeavour of Mr. Bursill, at page 127, to obtain a more favourable reception for Mr. Coles' patent anti-friction wheels than they have hitherto received at the hands of mechanical men. When Mr. Coles's scheme appeared in your 773rd Number*, the advantages claimed by the patentee were so extravagant, that I was induced to pen those strictures which appeared in No. 776,† and which I respectfully submit were neither "severe, hasty, nor undeserved." Mr. Coles, however, considered my remarks "calculated to annihilate his invention," although nothing but the irresistible force of *truth* could have given them any such potency. To ward off the consequences of my remarks, Mr. Coles published a pamphlet of such an objectionable character, that I felt myself called upon to make some reflections thereon—certainly and deservedly severe.‡

I should at this time have been well content to leave Mr. Coles' merits to find their proper level, which Mr. Bursill thinks seven years' publicity has not yet obtained for them, had not that gentle-

* Vol. xxix., p. 136. † Ibid, p. 179.
‡ Vol. xxx., p. 230.

man so pointedly referred to me at page 198, as to make it compulsory upon me to reply to his misrepresentations. Mr. Bursill remarks that, "it would have been more to the purpose if he (Mr. Baddeley) had tested the matter by practical experiment before denying the principle so publicly." The fact was, that from practical experience I denounced as fallacious the fine-spun and model-supported theory of Mr. Coles. I objected that Mr. Coles' friction-wheels were not placed in the true line of the forces to be neutralized; that the peripheries of anti-friction wheels, when the weight carried is considerable, are found to wear into facets; that Mr. Roberts (of Manchester) had made numerous experiments on a large scale with anti-friction wheels as applied to railway-carriages, which proved unsuccessful. These objections were surely *practical* ones, and to them I might have added the entire absence of *novelty* as well as *usefulness* in Mr. Coles' plans.

Mr. Coles' position is still what it was in 1838; not a single practical result can be adduced in support of the asserted superiority of his plan; no favourable opinions, save those of Dr. Church and the Earl of Dundonald!

Mr. Coles, like many other sanguine inventors, in order to coin a value for his invention, most exorbitantly overrates the actual loss attending the present state of things. It is generally agreed that, "by a degree of accuracy of mechanical construction, which is within the present limits of engineering skill, and by a good system of lubrication, the friction of the axle in its bearing may be reduced to an exceedingly small amount"*—not more than five pounds per ton. This "exceedingly small amount," then, is all that can possibly be saved; and if we admit (for argument's sake) that Mr. Coles' plan would save the whole of it, it requires but little acquaintance with arithmetic to perceive the fallacy of Mr. Coles' statement, that, to maintain a given speed, *half the power will be sufficient*, or, with the same power *twice the speed will be realized!* Now, I not only do not admit this extent of saving, but positively deny that *any* saving would accrue from the adoption of Mr. Coles' friction-wheels. "Many attempts have been made to reduce the friction of axles by the introduction of anti-friction rollers, variously disposed, the design being to convert the rubbing or sliding into a rolling action; but the generality of the contrivances for this purpose have had no other consequence than the *removal* of the friction from one part to another, and of weakening or encumbering the general structure by an unnecessary multiplicity of parts."*

In some experiments with two large heavy fly-wheels, the one mounted with the greatest possible care on anti-friction wheels, the other with ordinary bearings of the best construction, the latter was found to have an uniform advantage.

I beg to confess myself quite open to conviction; but where are the reasons which are to convince? What, beyond the fallacious performances of models, is submitted as proofs of the practical value of Mr. Coles' plan? Where are the parallel or identical cases demonstrative of their asserted efficacy? "Echo answers—Where?"

I remain, Sir, yours respectfully.

WM. BADDELEY.

29, Alfred Street, Islington,
March 23rd, 1846.

* *Mech. Mag.*, vol. xxx. p. 267.

## THE GUTTA PERCHA PATENTS. NO. III.

CHRISTOPHER NICKELS, YORK-ROAD, LAMBETH, *for improvements in the Binding of Books, &c.* Patent dated May 20, 1845; Specification enrolled September 20, 1845.

The objects specially comprehended under this patent are the "binding and covering of books, pamphlets, portfolios, writing-cases, and other similar articles."

*First.*—I use the gutta percha in a state of solution to connect or cement together at the back the sheets of books and pamphlets previous to their being boarded, or covered, instead of sewing and gluing, or stitching the same in the usual way. The process which I follow is similar to that adopted, and which is known by the name of "Caoutchouc Bookbinding;" that is to say, the sheets are first cut into single detached leaves by running a ploughing-knife along the back folds, or made up into double leaves, with a single back-fold; the volume of leaves is then roughed at the back by rasping or grating; and the cementing is effected by doing the back over with one coating, or two or more coatings of the gutta percha solution. For the sake of greater strength, I occasionally superimpose

* Engineers and Mechanics' Encyclopædia, vol. ii. p. 476.

over the coating or coatings of gutta percha, a strip of cotton, linen, or other cloth, a little wider than the back of the volume of leaves, cementing it thereto by a thin solution of gutta percha; or I insert in transverse grooves made at equal distances in the back of the mass of leaves by a fine saw or otherwise, and before applying the coating, or coatings of gutta percha, pieces of cord about twice as long as the back is broad. In the former case the overlapping parts of the strip of cloth, and in the latter, the projecting parts of the cord serve to connect the back to the boards, after the ordinary manner of bookbinding. The solution of gutta percha which I employ, is that obtained from the native substance after it has been cleansed and dissolved by the process for which letters patent for England have been granted to Richard Archibald Brooman, bearing date the 11th of March, 1845. When two coatings of the solution are employed, the second should be thicker than the first; that is, contain more of the gutta percha, in the proportion of four to two. The solution should in most instances be applied warm, and the coating allowed to dry before another is added, or before any cloth or other material is superimposed upon it.

*Secondly* — I use a solution of gutta percha of the same description as aforesaid as a substitute for paste, size, gum, or glaire, wherever the same are ordinarily employed in any of the processes of binding and covering other than that before described; as for example, in pasting in or down, as it is technically termed, the end-papers and joints, in attaching leather or vellum to the boards and backs, or in sizing for marbling and gilding.

*Thirdly*—I use a solution of gutta percha, of the same description as aforesaid, as a vehicle for colours in colouring and marbling the edges and covers of books, pamphlets, portfolios, writing-cases, and other similar articles.

*Fourthly*—I employ gutta percha in the sheet state, as a substitute for vellum leather, paper and cloth, in binding and covering the articles aforesaid. I either use the gutta percha in the plain sheet state in which it is manufactured and sold ready for use, under the patent of Richard Archibald Brooman,* varying the thickness according to the quality of binding or covering required; and then, if required, line, fillet, emboss, or otherwise ornament according to the modes in common use among bookbinders; or I make use of sheets that have been previously prepared and figured for the express purpose, by pouring a solution of gutta percha over an engraved surface to a sufficient depth, allowing it to cool, and then stripping it off. Or I make use of sheets that have been previously prepared and figured by the granular process, described in the specification of the patent of the said Richard Archibald Brooman; or I employ compound sheets of cloth and gutta percha prepared by covering the cloth with a layer of the gutta percha in the plastic state, or by giving the cloth one, two, or more coatings of the gutta percha in a state of solution.

And, *Fifthly*—I employ as a substitute for pasteboard in the binding and covering of the articles aforesaid, a composite material consisting of gutta percha blended with paper, pulp, or leather dust, or of bats or fleeces of wool, cotton, or other fibrous material cemented together by gutta percha, according to the modes pointed out in the specification of the before-mentioned patent of Richard Archibald Brooman.

The advantages attending the use of gutta percha in the different states and forms before specified, for binding and covering, are—*First*, a saving in most cases of time and expense, as where it supersedes the necessity for sowing or stitching, or of embossing or figuring each article separately; and—*Secondly*, a great increase of durability, the gutta percha, being in all its states, affected neither by cold water nor by damp, nor by any of the ordinary variations of atmospheric temperature, nor by oil or grease, and resisting also the ravages of insects.

When a degree of flexibility, more than is natural to gutta percha itself is required, I mix with the gutta percha a small portion of caoutchouc, say in the proportion of about two parts of caoutchouc for every eight parts of gutta percha.

* No. I., *Mech. Mag.*, No. 1180.

## THE TERRIBLE.

This splendid war steamer, being now ready for sea, was tried down the river on the 25th ult. She left her moorings at Woolwich at half-past 9 o'clock, A.M., and proceeded with apparently great speed, although against a strong tide. On reaching the measured mile in Long Reach, her speed was timed, and she was found to accomplish the mile in 5 minutes 34 seconds, or at the rate of 11·778 miles per hour. The knot was run in 6 minutes 28 seconds, or at the rate of 9·288 knots per hour, the engines making 13¼ revolutions per minute, giving an 8 feet stroke. The vessel arrived opposite Sheerness at exactly 12 o'clock, and at that time the engines were making 14 to 14½ revolutions per minute. The speed was then tried by two of Massey's logs, one from each paddle-box, and found to be, by one log with and against the tide, 10·92 and

10·95 knots; and with the other, 10·9 and 10·8 knots per hour. The engines during her progress worked remarkably smoothly, and her motion through the water is very steady, and free from the vibration so much felt in the majority of steam-vessels. The engines (by Messrs. Maudslay and Co.) are constructed on the double-action principle, and fitted with refrigerators and lubricators, and the works altogether have been so excellently adjusted, that they worked equally well, and with as little heating in any of the parts, on this her first trial, as if they had been twelve months at sea, and in constant exercise. The engineers of Messrs. Maudslay and Co.'s establishment attended to the engines during the early part of the day, but left them in the afternoon entirely to the management of Mr. Rundle, first engineer, and his assistants in Her Majesty's service. The important position which a first engineer now occupies when in charge of a vessel of 800 horse power, requiring so many engineers and stokers to work her, evidently requires that he should be a commissioned officer, to give him competent authority to act with decision in cases of emergency.—*Times*. [We are glad to see, from the observations at the close of the preceding extract, that the opinions first broached in this journal, as to the expediency of giving commission rank to the engineers of the royal steam navy, are beginning to make their due impression. ED. M. M.]

## LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65.

(*Concluded from page* 240.)

| Date of Registration. | No. in the Register. | Proprietors' Names. | Address. | Subject of Design. |
|---|---|---|---|---|
| 5 | 664 | Nathan Defries..... | 26, Grafton-st., Fitzroy-square.... | Gasometer induction apparatus. |
| 5 | 665 | Charles Bray..... | 14, Cranbourne-street, Leicester-square..... | A pair of scissors for cutting lamp cottons. |
| 7 | 666 | William Grunton..... | Harrington-square, Hampstead-road..... | Reading easel. |
| ,, | 667 | John Sinclair ..... | North Crescent, Bedford-square, Middlesex..... | The Sinclair indicator or self-instructing name-board for the pianoforte or organ. |
| 9 | 668 | W. H. Bentley ..... | Bedford, ironmonger ..... | Aquarian shower pot. [closets. |
| 10 | 669 | John Chatwin Stokes.. | Birmingham, plumber ..... | New shape of basin, for water- |
| 13 | 670 | Parker and Acott..... | Birmingham ..... | Improved elongated-pencil. |
| ,, | 671 | I. F. M. T. Mills ..... | Bishopsleighton, Devon..... | Engraving tool. |
| 14 | 672 | W. and J. Harcourt ... | Bristol-street, Birmingham..... | Improved bell carriage. |
| 17 | 673 | William Mathews..... | 10, Portugal-street, Lincoln's-Inn | Speculum. |
| ,, | 674 | George Blackmur ..... | 98, York-street, Commercial-road ..... | The Albert spring-stop for umbrellas. |
| ,, | 675 | John Fuller and Co., and J. Latchford... | 95 and 96, Long-lane, Southwark, and 180, Piccadilly, London ... | Ventilating hat. |
| 18 | 676 | Thomas Smith ..... | Hill House, Hampshire..... | Bit. |
| 18 | 677 | John Heather..... | 3, Bedford-court, Covent-garden | Splint and belt. |
| 19 | 678 | W. and J. Harcourt ... | Bristol-street, Birmingham..... | Improved lever bell-pull. |
| ,, | 679 | J. W. Sprules, and J. Proctor..... | Grange-road, Bermondsey ..... | Binding press. |
| 21 | 680 | James Murray..... | Dundee ..... | Improved whaling lance. |
| 23 | 681 | J. B. Rotheram..... | Whiston ..... | Improved thrashing machine. |
| 24 | 682 | Colton and Davies..... | 22, Cl.eapside, Liverpool ..... | Mill Stone. |

## LIST OF PATENTS GRANTED FOR SCOTLAND FROM THE 22ND OF FEBRUARY TO THE 22ND OF MARCH, 1846.

William James Cantello, of Paris-street, North Lambeth, Surrey, gentleman, for improvements in apparatus for hatching eggs and raising the young, and for heating hot-houses and other buildings. Sealed, February 26.

William Nairne, of Millhaugh, Perth, North Britain, flax spinner, for a new mode, or new modes of propelling carriages along railways. March 2.

David Yoolow Stewart, of Montrose, Scotland, ironfounder, for improvements in moulding iron and brass. March 2.

Juan Nepomuceno Adorns, of Mexico, in the Republic of Mexico, gent., for improvements in manufacturing cigars and other similar articles, March 2.

John Harcourt Brown, of Brunswick-place, Barnsbury-road, Middlesex, gent., for improvements in securing letters, envelopes, covers, despatches, packets and parcels. March 2.

Henry Dircks, of Nicholas-lane, London, engineer, for improvements in the means of obtaining and preparing extracts from certain vegetable matters, and in the apparatus connected therewith, which apparatus may be also applied to other similar purposes. March 4.

Charles Hague, of Oldham, Lancaster, brassfounder, and William Madeley, of Manchester, in the said county, machine maker, for improvements in, or applicable to, certain machines employed in the slubbing, roving, or preparing to be spun, of cotton and other fibrous substances, and an improved apparatus for lubricating shafts, and bearings of, or in such machines for the purpose of reducing friction, and which apparatus is also applicable to other shafting and machinery. March 9.

Elisha Haydon Collier, of Goldsworthy-terrace, Rotherhithe, Surrey, civil engineer, for certain improvements in the manufacture of nails, and in the machinery or apparatus to be used for such purposes. March 10.

Erastus B. Bigelow, of Boston, in the State of Massachusetts, of the United States of America, for certain new and useful improvements in looms for weaving certain kinds of carpets or other fabrics of like character. March 11.

John Thomas Perkins, of Monmouth-street, Middlesex, pattern card-maker, for certain improvements in machinery or apparatus for cutting paper and other fabrics. March 11.

William Edward Newton, 66, Chancery-lane, Middlesex, civil engineer, for improvements in the preparation or manufacture of thread or yarn. (Being a communication from abroad.) March 12.

James Parmer Budd, of Ystalyfera Iron Works, Swansea, merchant, for improvements in the manufacture of iron. March 13.

## NOTES AND NOTICES.

*A machine for baking bread by steam* has been invented by a M. Violette which consists of two concentric cylinders, between which steam at a high temperature is allowed to circulate. The interior cylinder contains the dough, which is pierced with a great number of very small holes; the steam which circulates between the cylinders penetrates by these holes into the interior, and distributes the heat uniformly throughout the mass; and after the lapse of half an hour the steam is let off, and the bread removed.—*Moniteur Industriel.* Of course the bread will have to be dried after it has undergone this steaming process. A much better plan is that known in this country as James's Patent, in which the heat of the steam is conveyed indirectly to the bread through the medium of a number of cellular plates.

*The Croydon Atmospheric Railway.*—The fact is no longer concealed that the application of the Atmospheric system to this railway has, up to the present moment, proved a failure. The speed maintained is capriciously variable and uncertain, long pauses are not unfrequent, and stoppages of common occurrence. Some say it is the engines which are in fault; others, that it is the valve; and others again, that it is the mixture employed to seal the valve, which is one moment as cold as ice, and the next melting as charity. Sir Francis Head, (who was one of a load of passengers who were obliged the other day to alight and complete their journey on foot to Croydon,) on being asked the cause, gave as his version of the matter, that the *railway had fainted away.*

*Hale's War Rocket.*—Some interesting experiments were made with this rocket last week at Woolwich. It differs principally from the common rocket in having no stick. Sixteen of Mr. Hale's 6-pounder rockets were fired at various elevations from a small portable apparatus, which allows of their being fired from a small boat quite as effectively and conveniently as from the deck of a line-of-battle ship. The first four fired were projected in a horizontal direction with the greatest precision, and struck the water at distances varying from 500 to 700 yards, after which they rose at 700 or 800 yards further, *en ricochet.* The other 12 were fired at a greater elevation, and before striking the water *en ricochet* went a distance of from 2,000 to 3,000 yards, and their direction varied but very slightly. After the firing of Mr. Hale's rockets, six of the "service" 12-pounder congreves were fired as a comparative experiment, at the same elevation as Mr. Hale's, but from a tube 15 feet long, which ranged about the same distance as Mr. Hale's, and also pursued a very good direction. The 12-pounder rockets now in use in the navy and army have sticks attached to them nine feet long, and the length of the stick increases in proportion to the weight of the rocket; thus a vast amount of space, very valuable in stowage, is wasted; whereas Mr. Hale's invention requires no such expensive and inconvenient auxiliaries, and is, of course, more economical, less cumbersome, and infinitely less liable to become unserviceable from damage.

*The Sir Henry Pottinger* is the name of a new war steamer which was launched last week, by Messrs. Fairbairn and Sons, of Millwall. She is said to be the largest iron steam-ship yet built, with the exception of the Great Britain. She differs from that vessel in having paddle-wheels instead of the screw propeller. Her tonnage is 1,225 tons; her length of keel and fore-rake is 209 feet, her extreme breadth 35 feet, her depth in the hold is 21½ feet, and her engines will be 450 horse power. She is intended for the China line, from Ceylon to Hong Kong, and will carry the government mails. Her engines are building by Messrs. Miller and Ravenhill.

*Steam to Brazil.*—A beautiful large iron steamer was launched last week from the building-yard of Messrs. James Hodgson and Co., Liverpool, and called the *Antelope.* She is the first of a line of eight steamers, on the screw principle, which are intended to ply between that port and Brazil. She is 600 tons burden 175 feet long, 26 feet 4 inches in beam, and 17 feet deep. Her propeller will be worked by a pair of engines of 100 horse power, or 50 horse power each. She is to be rigged as a ship, with very heavy masts and rigging.

*Explosion of Ice.*—The *Missouri Statesman* has the following account of a singular phenomenon which occurred on the night of the 26th ult., in a lake opposite Rocheport:—A tremendous crash was heard about four o'clock in the morning, and several persons visited the ice at day-break. From the appearance of the lake it was evident that it had been upheaved with great violence by the agency of some subterraneous power. Large pieces of ice stood on end on every side of the spot at which the great deep had been broken up; and in some places large heaps of the frozen element had been made from six to twelve feet high. Upon the surface of the unbroken ice around the spot where the breach was made lay numbers of fish, some of large size, also quantities of mud, most evidently dislodged from the bottom of the lake. The water in the lake is about ten feet deep.

*The Nebular Hypothesis.*—Professor Nichol has written to the editor of the *Glasgow Argus*, that the Nebular Hypothesis is no longer tenable. The ground of Sir William Herschel's opinion, he says, was this, that many dim spots existed in the sky whose irresolvability could not be accounted for, without a supposed break in a line of induction that otherwise seemed continuous. The chief of these test spots was the nebula in Orion. Lord Rosse writes me:—"I think I may safely say that there can be little, if any doubt as to the resolvability of the nebula." Referring to unfavourable circumstances, he adds, "All about the trapezium is a mass of stars, the rest of the nebula also abound with stars, and exhibiting the characteristics of resolvability strongly marked." Without doubt, then, the Nebular Hypothesis must be abandoned.

*Steam Balloon and Aerial Gun Battery.*—A correspondent of the *New York Mirror* says:—A Mr. Patton, of Virginia, is making a great stir relative to a steam-balloon he has invented, and by which he proposes to carry despatches to Oregon in a few hours. In addition to this, he says he can connect with the balloon a battery of such tremendous power, that it would shower down balls in such numbers that no army could withstand them. He hopes that a select committee will be appointed to test the invention by a short experimental voyage to Texas and back again. He would prefer that a certain Dixon H. Lewis should be chairman, as his great bulk would tend to keep the "balance of power" in the car of the balloon.

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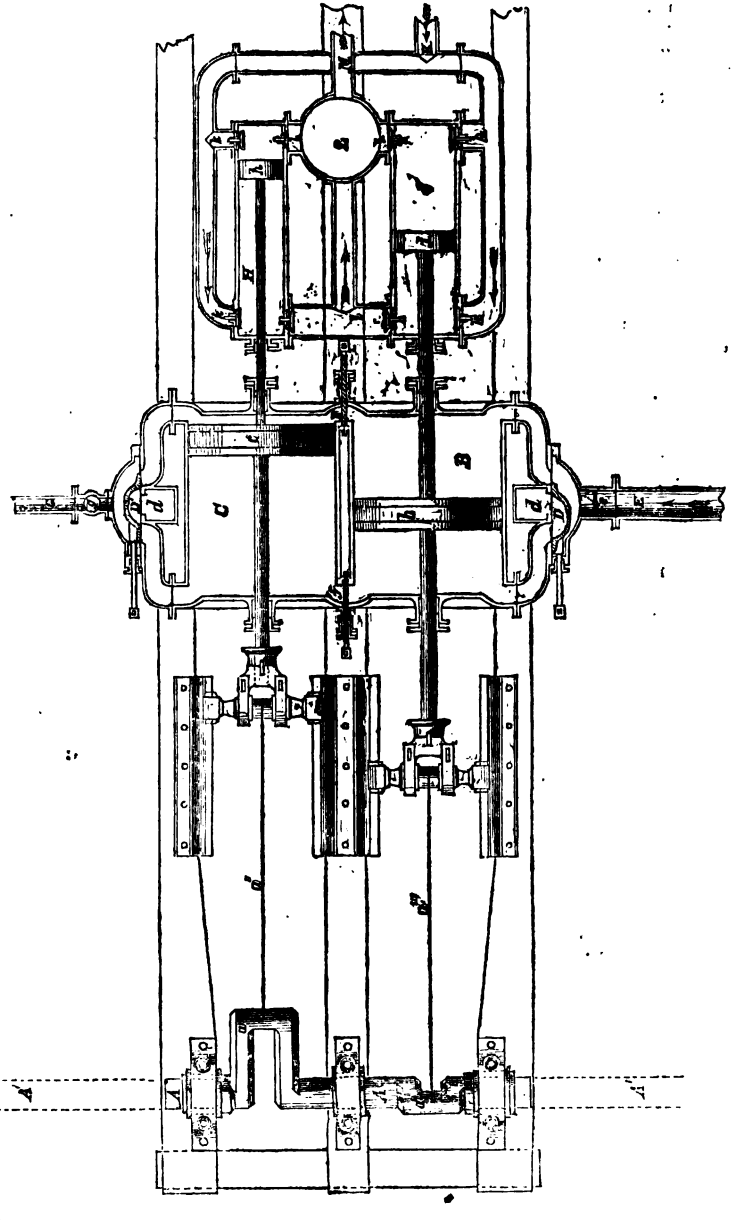
CAPTAIN ERICSSON'S LATEST IMPROVEMENTS IN THE STEAM ENGINE AND STEAM NAVIGATION.

Fig. 1.



## CAPTAIN ERICSSON'S LATEST IMPROVEMENTS IN THE STEAM ENGINE AND STEAM NAVIGATION.

[Patent dated September 18, 1845; Specification enrolled March 18, 1846.]

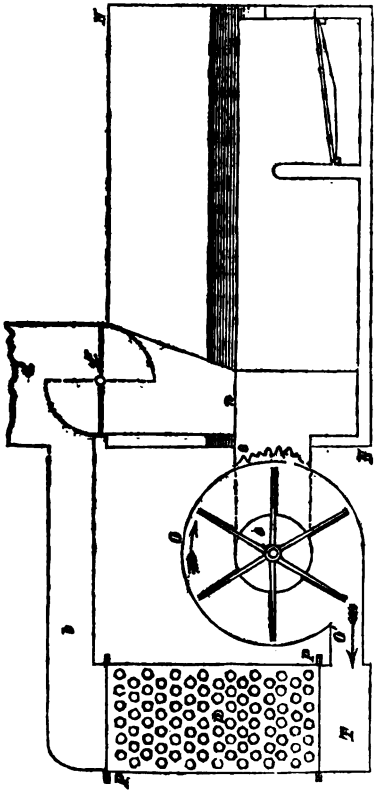
THE present improvements of Captain Ericsson have been patented on his behalf in England by Mr. S. H. Perkins (as a "communication from a foreigner residing abroad,") and are thus described in Mr. Perkins's Specification, which we give at length—omitting merely the formal parts. They are distinguished, like all Captain Ericsson's inventions, by great ingenuity, and not exceeded by any of them in promise of practical utility.

"The nature of the said improvements in the steam engine consists in employing two cylinders, the pistons of which are connected to cranks placed at right angles, or nearly so, and in which the steam is made to act simultaneously on both pistons during part of the stroke, by keeping a free communication open during the same part of the stroke between the said two cylinders, whereby the steam is worked highly expansively, and a more regular force obtained than there would be by working the steam expansively to the same high degree in ordinary crank engines, and a great saving of fuel is thus effected, which is augmented by applying a centrifugal suction and blowing apparatus to the exit flue of the boiler that supplies them with steam; which apparatus is made to draw the hot air from the exit flue and force it through a heater composed of a series of small tubes, through which the feed-water passes on its way to the boiler. And the nature of the said improvements in the application of the steam engine to the navigation of vessels, (having reference more particularly to such as are propelled by spiral stern propellers,) consists—*Firstly*, in employing a cylindrical drum or wheel, which I call the hydrostatic rotator, attached to the propeller shaft, and made to revolve within a cylinder by hydrostatic pressure acting on radial sliding wings in the circumference of the rotator, which hydrostatic pressure is obtained by means of pumps attached to the piston-rods of the steam cylinders, the fluid used being conveyed through pipes [illegible] necting these pumps with the cylinder which contains the rotator. And, thus *dly*, in employing a hollow shaft [illegible] d to the axis of the rotator, which [illegible] LC the propeller shaft to be drawn in and out, for the purpose of disengaging the propeller, by means of a radial arm attached to a shaft supported by a bearing bolted to the side of the stern post; and the manner in which the said invention in the several parts thereof is performed, is represented in the engravings, and in the following description thereof:"

### *Description of the Engravings.*

Figure 1 represents a top view, on an enlarged scale of the steam cylinders, crank shaft, and pumps before mentioned. A A, is the crank shaft; *a a'*, cranks placed at right angles; *a'' a'''* connecting-rods for communicating the force of the pistons to the said cranks in the usual manner; B, larboard cylinder, and *b* its piston; C, starboard cylinder, and *c* its piston. D D', slide valves worked in the ordinary manner for conveying steam to and from the cylinders; *d d*, eduction pipes for conveying the steam into ordinary condensers. E, main steam pipe for conducting the steam from the boiler to the cylinder B; *e* is a throttle valve in the main steam pipe, worked in the ordinary manner, to be opened when the piston, *b*, commences its stroke, and to be closed when the same has travelled about one-half of the length of the cylinder B; F *f*, slide valves, which open or close a communication between the cylinders B and C, these valves being worked either by tappet-wheels or eccentrics applied to the crank-shaft, and so arranged, that when the piston, *c*, commences its movement from right to left, the slide valve, F, will be opened, and closed when the said piston shall have performed half its stroke, the slide valve, *f*, being at the same time so arranged as to open when the piston, *c*, commences its movement from left to right, and to close when the piston is at half stroke. G is a small steam pipe communicating with the steam boilers; and *g*, a stop-cock therein for shutting off the communication with the boilers; H and J, double-acting force pumps; *h* and *j*, buckets attached to an extension of the piston-rods of the pistons, *c* and *b*; K, main suction pipe; *k k k k*, branch suction pipes for supplying the pumps, H and J; L,

Fig. 2.



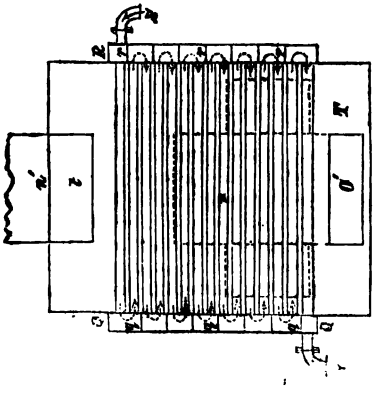


Fig. 3.

a receiver; *l l l*, pipes for conducting the fluid from the pumps to the receiver; M, main pipe for conducting the fluid from the receiver.

Figure 2, represents a longitudinal section on the centre-line of the boiler, centrifugal apparatus, and heater; and fig. 3, a transverse section of the heater; N N, longitudinal section of an ordinary marine boiler; *n*, exit of the flues into the chimney; *n'* *n''*, a damper placed in the lower part of the chimney for shutting off the communication between the exit flue and the chimney, when the centrifugal apparatus is to be put in operation. O, is a cylindrical box containing a centrifugal blower or fan-wheel; *o o*, pipe forming a communication between the exit-flue of the boiler and the centre of the fan-wheel; *o'*, pipe for conveying the air from the centrifugal blower under the heater. P P, a box made of sheet-iron, containing a series of small tubes, the centre one of which is marked *p*.

These tubes are inserted into corresponding sides of the boxes, Q Q, and R R, fig. 3, these boxes being provided with a series of partitions, *q q q q q q q*, *r r r r r r r*, so placed as to form an alternating communication between the ends of the tubes; S, a pipe communicating with the force-pump, which supplies the boiler and the upper compartment of the box, R R; *s*, pipe for conveying the water from the lower compartment of the box, Q Q, to the boiler. The course of the water in passing from S to *s* through the series of tubes, is indicated by the dotted arrows. T, box below the heater which receives the hot air from the centrifugal apparatus previous to its entrance and distribution among the series of tubes; *t*, pipe for conducting the air from the heater to the chimney *n'* above the damper *n''*.

(*To be continued in our Next.*)

## ELECTRO-MAGNETIC PHENOMENA.

Sir,—From a long and deliberate consideration of electro-magnetic phenomena, I am induced to believe that the secret of nature's plan in producing her various anomalous effects is yet under a cloud, which neither the hypothesis of Ampére, nor later experimental research, has conduced much to dispel. A principle

there is, however, which I have long descried in these workings of nature, by which it seems to me all these anomalous effects may be reconciled.

There is a phenomenon familiar to all, which is induced in water when it flows through a limited orifice below where its free spontaneous flow towards the central duct is resisted; namely, it is thrown into a path of parallelism developed in helical motion. Like phenomena is at times induced in the air; and once I beheld a more subtle fluid than either quoted, spin round, as it passed, like an *electric whirlpool* from sky to earth.

But in no case in nature, nor probably even in the planetary ocean, is there a more perfectly constituted case for the development of the principle deduced, than in electric and magnetic induction.

Let a surface equal to the section of area of the wire conducting a current of positive electricity be taken at any part along the wire, it will be equal to supply the quantity of induced current flowing from a *right angle* of induction parallel to the wire; but as every point of the whole surface of the wire tends to produce as many such currents as the whole surface of the wire numbers the area of its section, it follows, that for the induced currents to pass from end to end of the wire, it must also flow round about the wire at the same time for the whole to enter and deliver in lines of parallelism.

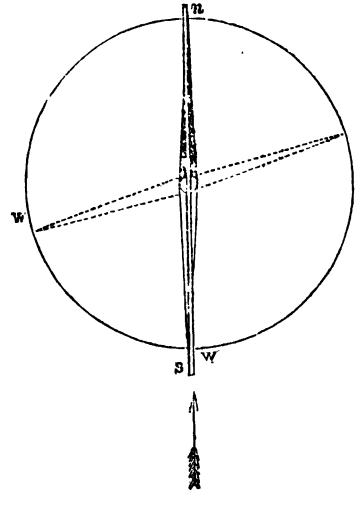
Currents of magnetism will also fall into vertical motion around the south pole of magnets, where Faraday's "beam of light" will be thrown round; and diamagnetic bodies, with length developed, be thrown tangentially to the circulating fluid by the slight impinging force due to its *materiality*. For it is a fact, that the repulsive force which Faraday mentions in contradistinction to the attractive force of magnetism, is actually not stronger than the *whip* of a *gnat's wing*.

With a common horse-shoe magnet, a great variety of "diamagnetic" motions can be induced—depending on the *exact* position of the poles of the magnet in relation to the centre of suspension of the body affected—and it will be found that when the poles of the magnets are directed upwards or downwards to within half an inch or so of the body, that force turning, it operates stronger. Also, that by inverting the poles, the motion is reversed, that is to say, is *right-handed*, or *left-handed*, according as the body receives the influence from *above* or *below*.

Mechanical effect is not all, however, the principle in question can *induce*, as the following showeth:—

When a wire of steel is laid across another conveying a current of electricity, its electricity inducting into the flowing current leaves it in a negative condition; upon which the vortical flow—the earth's magnetism—passes into the wire at the end towards the current, and flows through under the direction of its influence, as it will afterwards continue to do under the influence of natural currents of electricity or magnetism. The charge from a Leyden-jar, will so *jar* the uniformity of the vortex, as to account for the variety of magnetic effects produced under its influence. But time, and your valuable space, is also a consideration that must now be looked to, as I have yet to run over the accompanying diagrams illustrative of the action of the vortical current on the magnetic needle.

Fig. 1.




In fig. 1, the current is driving in the direction of the arrow, and the vortical flow is turning right-handed; therefore, the south pole of the needle turns into the flow from *e*, and the north pole from it towards W. In fig. 2, there is shown eight descending currents *e*, *e'*, *g*, *g'*,

Fig. 2.

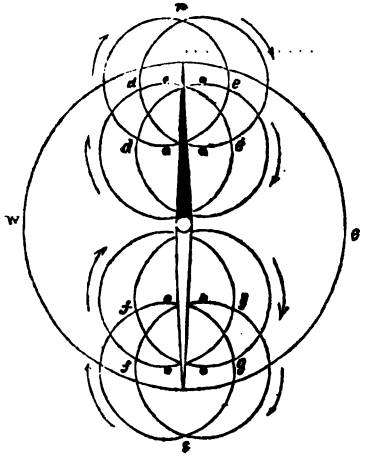
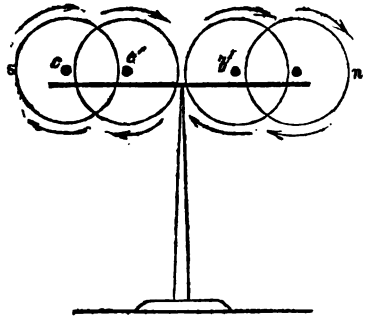


Fig. 3.



&c., &c., with the induced currents turning right-handed. Their influence on the needle can be read as follows:—*d* attracts, *d'* repels; *e* repels, *e'* attracts the north pole: *g* attracts, *g'* repels, *f* repels, *f'* attracts the south pole.

In fig. 3 are shown four wires exciting right-handed currents flowing above the needle, and acting as follows:—*b* attracts, *b'* repels, the north pole; *e* attracts, *e'* repels the south pole.

I remain, Sir, yours respectfully.

M. S.

London, 26 Feb., 1846.

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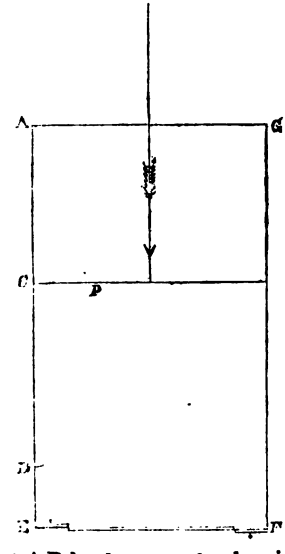
PARSEY'S COMPRESSED AIR-ENGINE.

Sir,—I have lately, in consequence of what has appeared in your Magazine, paid some little attention to the principle of "Parsey's Air Engine." The able manner in which your correspondents have treated this subject would seem to preclude the necessity of further remarks: I am, however, induced to trouble you with these few observations, even at the risk of their being considered an intrusion.

I shall confine my remarks entirely to the abstract principle by which the motive power is produced.



Let A B be the pump for charging the receiver; P, the piston (here represented in its *n*th down stroke,) resisted by a pressure continually increasing until it arrives at a point D, at which the air becomes of sufficient density to open the valve, F, and pass into the receiver, and is therefore of the same density as the air in the receiver.

Put AB = *l*, *a* = the area of the piston, *d* = the atmospheric pressure, $d^1$ $d^2$, to $d^n$ = the density of air in the receiver after 1, 2, &c.—*n* strokes of the condensing pump, *r* = the capacity of the receiver.

Then, since *al* = the contents of the pump, we have by the known laws of pneumatics, as capacity of receiver: density of atmosphere: : capacity of receiver + capacity of pump: density after one stroke of pump; or $r : d :: r + al : d^1 = \frac{d(r+al)}{r}$; and, again,

$$\therefore r+al : d^1\left(=\frac{d(r+al)}{r}\right) :: r+2\,al : d^2=\frac{d\,(r+2\,al)}{r};\ \text{or generally,}$$

$$d^n=\frac{d(r+nal)}{r} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1).$$

Therefore, since density in receiver : density of atmosphere :: AB : BD ; we have $\therefore \frac{d(r+nal)}{r} : d :: l : \frac{rl}{d(r+nal)}=\text{BD}. \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2).$

Let the piston have arrived at any point C, put BC$=x$. Then, since the air when admitted into the pump is always at the pressure $d$,

$\therefore x : da :: l : \frac{dal}{x}=$ pressure on P when it arrives at C.

Now, the work done by any force is always equal to the force drawn into the distance through which it travels; and consequently, if we take an exceedingly small space $dxdw=\frac{dal}{x}dx$.

Integrating for $x$ between the limits of $=x2$ and $x=$B D $\frac{rl}{r+nal}$, we have

$$*w=dal\left\{\log.^{\varepsilon} l-\log.^{\varepsilon}\frac{rl}{r+nal}\right\}=dal\ \log.^{\varepsilon}\frac{r+nal}{r} \ldots (3).$$

Which is the effective work done by the piston in passing from A to B during the $n$th stroke; and the total work performed by $n$ stroke, is

$$\text{W}=dal\left\{\log.^{\varepsilon}\frac{r+al}{r}+\log.^{\varepsilon}\frac{r+2al}{r}+\&\text{c}.\ldots\ldots\log.^{\varepsilon}\frac{r+nal}{r}\right\}$$
$$=dal\ \log.^{\varepsilon}\frac{(r+al)\,(r+2al)\,.\,\&\text{c}\ldots\ldots\ldots(r+nal)}{r^n}.$$

Now, let us see how much work we can get out of the engine from the air pumped in during $n$ strokes, supposing it to be expended at a constant pressure $p$. The capacity of the pump being $=al$, the quantity of air pumped into the receiver during $n$ strokes $=nal$; this multiplied by $d=dnal$, and would be the work done if it were acting against a vacuum. But because the atmosphere opposes a resistance, its effect has to be deducted, therefore $p : d :: nal : \frac{dnal}{p}=$ the space occupied by the air when compressed to a density, $p$; and if we multiply this by $d$ we shall have $\frac{d^2nal}{p}=$ effective resistance from the atmosphere to the working of the engine under the pressure $p$; hence

$$\text{W}=dnal-\frac{d^2nal}{p}=dnal\left(1-\frac{d}{p}\right)\ldots\ldots\ldots(5)$$

which is the quantity of work given out by the engine from the air pumped in by $n$ strokes of the condensing pump.

*Example.*—Let the length of the cylinder $2=10$ feet, the area of the piston $=1$ foot $=144$ ins., the pressure of the atmosphere per square inch $=15$ lbs., the cubical contents of the receiver $=10$ feet, the pressure at which the engine $=60$ lbs. per square inch, and the number of the strokes given by the pump $=n=20$; then (equation 4,)

$$\text{W}=dal\ \log.^{\varepsilon}\frac{(r+al)(r+2al)\ \&\text{c}.\ldots(r+nal)}{r^n}=$$
$$15\times144\times10\left\{log.^{\varepsilon}\frac{10+10\cdot10+20,\&\text{c}.\ldots10+200}{10^{20}}\right\}$$

* Correctly I should have integrated for $x$ between the limits of $l$ and $\frac{rl}{r+(n-1)al}$, for the work done by the piston from A to B, and have added the amount of work done from D to B under the varying pressure of from $\frac{rl}{r+(n-1)\,al}$ to $\frac{rl}{r+nal}$, and deducted from the sum $dal$ (that being the work performed by the pressure of the atmosphere through the whole stroke,)—the difference being the absolute amount of work performed by the piston during the $n$th stroke. But as the variation is too small practically to affect the result, I have adopted the above for its simplicity.

which by reduction becomes $W = 15 \times 144 \times 10 \times 45{\cdot}388 = 980380$ = the quantity of work done to force twenty cylinders of air into the receiver.

Again (equation 5,)

$$W^1 = dnal\left\{1-\frac{d}{p}\right\} = 15 \times 20 \times 144 \times 10\left\{1-\frac{15}{60}\right\} = 324000 =$$

work done by the engine in giving off twenty cylinders of air, and

$W - W^1 = 980380 - 324000 = 656380 =$ the loss on twenty cylinders full of air.

The loss of power becomes greater as the pressure on the receiver is increased, for as the same quantity of air is injected into the receiver at each stroke of the pump, no greater power than

$$\frac{dnal\left(1-\frac{d}{p}\right)}{n} = dal\left(1-\frac{d}{p}\right)$$

can be obtained from it, and this is the constant effect of each cylinder full of air when working the engine. But if we refer to equation 3, we shall find that the force required to inject the air increases, as the pressure on the receiver increases.

*Example.*—Let the pressure on the receiver be 99 atmospheres in excess of the atmospheric pressure, then from the dimensions given above, there must be 99 strokes of the piston to produce it; consequently (equation 3,)

$$w = dal \log^{\epsilon} \frac{p + nal}{r} = 15 \times 144 \times 10 \log.^{\epsilon} \frac{10 \times 99 \times 10}{10}$$
$$= 21600 \times 46052$$
$$= 99472 =$$

power required to force down the piston from A to B when there is 1485 lbs. effective pressure per square inch on the receiver; nearly; but

$$dal.\left(1-\frac{d}{p}\right) = 21600\left(1-\frac{15}{60}\right) = 16200$$

Therefore, the lost power from each stroke of the pump, when the pressure in the receiver is 99 atmospheres above the atmospheric pressure, is $99472 - 16200 = 83272$, or 83·7 per cent. nearly; and this does not include the loss from friction, leakage, &c.

I am, Sir, yours &c.,

M.

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THE COMPRESSED AIR-ENGINE.

Sir,—Having read some of the paragraphs which appeared in many of the public journals a few weeks since, relating to "Parsey's Compressed Air-engine," I felt interested in the subject, and made a visit to see the exhibition of the model.

Its performance pleased me. The little machine traversed the room, from end to end of its miniature railway, with ease, celerity, and smoothness, unaccompanied by those disagreeable attendants of an ordinary steam locomotive—emitted steam, smoke, and other unpleasant matters; and I could not but conclude, that if these desiderata, and the other advantages claimed for the invention enumerated in the company's prospectus, were to be possessed by a working engine on the plan of the model, it would be a very desirable substitute for the steam locomotive, and could not fail of success. So much did I feel this conviction, that, although addicted in no way to speculate in the projects of the day, yet I half resolved, before leaving the room, to apply for shares in the proposed company, impelled by a desire of assisting to bring the invention into use, by a practical application of it to common railways, and being, at the moment, almost disposed to rely on the patentee's statement for accuracy concerning the powers which such an engine would possess. I hesitated, however, and the half resolve was not matured, because I was unable, by any process of reasoning or calculation, to confirm the propositions which this statement contained, and more particularly the following; namely—"that a

quantity of air could be readily compressed and held in the receivers of a working engine constructed according to the model, of the usual size of a steam locomotive, sufficient to form a motive power for the traction of an ordinary carriage-train of 40 tons a distance of 60 miles; and that this power was much more than adequate for what in practice was likely to be required, inasmuch as the principal stations on any lines of railroad where it would be employed, at which stationary engines would be situate for compressing the air, would not be, it was probable, more than about 30 miles apart, and consequently that it would be necessary to supply power for no greater distance at any one time." The points involved in this proposition, then, I considered to form the hinge on which the utility of the invention would depend; and I left the room intending to try, by demonstration, if these capabilities could be made out. A little reflection, however, caused me to think the powers of the engine had been miscalculated; and I made a second visit to the exhibition, for the purpose of endeavouring to obtain from the persons in charge of the model some data on which the calculation of the patentee had been made, when I was presented with a small pamphlet, entitled "Notices of the Press." These notices are extracted from the *Times*, and other public newspapers; and the last of them purports to be from the *Mining Journal*, 21st Feb., and is signed—"An Engineer." Whether "*An* Engineer" be *the* engineer, I cannot tell. In the article, however, are given data such as I was in search after, and various calculations are made, showing results corresponding to—and so far, *if correct*, confirmatory of the patentee's statement. The accuracy of the "Engineer's" reasoning being established, it would form a ground to entitle the invention to public confidence, and give a reasonable hope of its successful application. My reasons for not entertaining a favourable opinion of it, after perusing the article, I now proceed to explain.

The article commences by stating, that Stephenson's Engine, according to Tredgold, has drawn 40 tons at 35 miles per hour; that the engine evaporated 77 cubic feet of water per hour, *i. e.*, converted that quantity of water into steam; that the utmost quantity of steam at 212° (*i. e.*, under the mean atmospheric pressure, which is 2,120 lbs. on the square foot) that can be generated from a cubic foot of water, is in bulk 1,711 cubic feet. A calculation follows from these data, showing that the power of the steam so produced is equal to 279,303,640 lbs. raised 1 foot per hour, concluding that this is the quantity of power requisite to draw a train of 40 tons at the speed of 35 miles in 1 hour. The article then proceeds: "If the reservoir in a compressed air-engine have a capacity of 100 cubic feet, and be charged with 60 atmospheres (*i. e.*, 60 times 100 cubic feet of air at the ordinary atmospheric density,) there will be a pressure of 900 lbs. on every square inch of the receiver, or 129,600 lbs. per foot of surface. The power contained will therefore be

$144 \times 100 \times 60 \times 450 = 387,800,000$ lbs.

raised 1 foot, which will be more than equal to the power of 77 cubic feet of water converted into steam at 212°, and consequently will be sufficient to draw a train of 40 tons at the speed of 35 miles per hour."

Here, then, is a foundation for the statement of the patentee. Is it solid? Is there no fallacy in the calculation? Examine the elements (terms) of the first side of the equation: 144 is the number of square inches on the surface of one side of a cubic foot, or the area of the sustaining surface of a cubic foot of matter employed in raising a body 1 foot high; 100 represents, in cubic feet, the capacity of the reservoir, or vessel containing the matter so to be employed—namely, the compressed air; 60 represents the density of the matter or air so contained, in its relation to the density of the common atmosphere, being the number of volumes of atmospheric air compressed together and held in the reservoir. Now, if the first of these terms be multiplied by the second, the result will give, in square inches, the extent of the sustaining or operating surface of the whole quantity of air contained in the reservoir, supposing it to be employed for raising a body 1 foot high, at the density at which it is compressed therein; at which density it is capable (as above stated) of sustaining or exerting a pressure of 900 lbs. per square inch of surface. If this result be multiplied by the next term (60,) the further result will give, in square inches, the extent of the

sustaining or operating surface of the whole quantity of air contained in the reservoir, if employed at the common atmospheric density, and by being so employed, its volume will be increased 60 times, but its power of operating will be reduced in like proportion, or to 15 lbs. per square inch, the common atmospheric pressure. Hence, to obtain the mathematical expression of the amount of power contained in the reservoir, in lbs. raised a foot high, the resulting multiple, if the 60-term be employed, should be multiplied by 15, or, if the 60-term be omitted, the preceding multiple should be multiplied by 900; in either case, the same final result will ensue, viz., 12,960,000; and this number (and not 387,800,000) accurately expresses the elastic force or amount of power which may be obtained from the whole contents of the reservoir in "lbs. raised 1 foot." The error in the calculation of "An Engineer" is, from his having used as his fourth term, the number 450—this being the middle number between 900 and 0, which he conceives to represent "a medium working pressure" that the contents of the reservoir may be capable of being made to exert. It is almost needless to do more than point out this fallacy, as the slightest reflection must make it apparent that this medium power can only be obtained by employing the air of the reservoir at such a medium moderated density as that its volume shall be only double of that at which it is compressed; and in such case the preceding term, instead of being 60, should be only 2. Another occasion, however, will be afforded for adverting to this error subsequently in my letter. Now, Sir, 12,960,000 is so far from being equal to 279,303,640, (the number of lbs. required, as shown by deduction from the data of Stephenson's engine,) that it is scarcely more than 1-22nd part of that quantity; and consequently, on the above data, the power of the contents of the reservoir, instead of being sufficient to draw the train of 40 tons a distance of 35 miles, would only suffice to draw it about ½ mile, when its whole force would be expended.

Again; at the end of the article by 'An Engineer" (after having previously stated, that "it is in evidence that the *maximum* power of a locomotive engine is 3,000 lbs. tractive force,") is this passage—"Estimate of the size of a locomotive air-engine magazine (reservoir) to travel 60 miles with a traction of 3000 lbs." A calculation then being made of the number of lbs. of elasticity which will be required to be compressed for such a purpose, and shown to be 1,188,000,000, the article proceeds:—

"Let it be proposed to compress the air to 1,000 lbs. pressure, *which will give a medium working-pressure of* 500 lbs. *per square inch;* 1,000 lbs. pressure per square inch is equal to 66 atmospheres, consequently a column of air compressed into 66 times its density, 1 foot high, and 1 inch square at the base, will lift 500 lbs. 66 *feet high, or* 33,000 lbs. 1 *foot high*, consequently, a column of compressed air of 66 atmospheres being 1 foot high and 1 foot square (144 square inches) at the base, will lift 33,000 × 144, or 4,752,000 lbs. 1 foot high. Then, as 4,752,000 will require one cubic foot, what will 1,188,000,000 lbs. require? Answer, 237 cubic feet." It is, I suppose, upon some such calculation as this that the patentee rests his assertion, that the engine could contain sufficient motive power to draw a train of 40 tons a distance of 60 miles. What are its fallacies? At the commencement, a similar one to that before pointed out; namely, that the air being compressed to 1,000 lbs. pressure "will give a medium working pressure of 500 lbs. per square inch." This is true, as before mentioned, if the engine be worked by the air at a density at which its volume will be only *double* of that at which it is compressed in the reservoir; but in that case, the whole contents of the reservoir will be *very soon* exhausted, and the distance travelled *very small.* It is, on the contrary, proposed to employ it at such a greatly modified density as that its power may be longer exerted; and it is one of the chief merits claimed for the invention, that by its "self-acting regulator" the exact amount of force, and no more, will always be applied to the pistons which shall be requisite to produce the proper speed. This notion about "a medium working-pressure" in the mind of "An Engineer," has led to what follows next in his statement; that "a column of air 1 foot high, and 1 inch square at the base, compressed into 66 times its density, will lift 500 lbs. 66 feet high." Assuredly such a column will lift 500 lbs. *only* 2 *feet high*, or 1,000 lbs. (not 33,000 lbs.) 1 foot high.

This is evident; for it is one of the data upon which the calculation is made, that a compression of 66 atmospheres has a force of "1,000 lbs. pressure per square inch." Now, correcting what follows by substituting 1,000 for 33,000, and multiplying by 144, the multiple will be, not 4,752,000, but 144,000,—and substituting this as the true term in the subsequent proportion, the answer will be, not 237 cubic feet, but 8,250 *cubic feet* (!!) as the size of a reservoir required for an engine to travel 60 miles, the air being compressed to a density of 66 atmospheres!!

Now, Sir, to corroborate my position I adduce proof derived from a different method of calculation,—more simple and practical. Suppose the compressed-air locomotive which is proposed to be constructed, to have driving-wheels of 7 feet diameter, and peripheries measuring 22 feet. Let the pistons have discs each of about 14 inches diameter, or with surfaces containing 144 square inches, or 1 superficial foot, and to have 18 inches stroke. These dimensions are, I believe, not very different from those of many of the engines of ordinary steam locomotives. Now, the peripheries of the driving-wheels being 22 feet, it follows, that they will revolve 240 times in travelling a distance of one mile, and at each of such revolutions there will be an up-and-down stroke of each piston. As each piston has 1 square foot of surface on the disc, working with a stroke of 1½ foot, it follows, that 1½ cubic foot of air at the working density will be required to give a single motion up or down to each piston, and consequently, that 6 cubic feet of air at the working density will be exhausted from the reservoir at each revolution of the driving-wheels; and there being 240 of such revolutions in a mile, for travelling this distance 1,440 cubic feet of air, at the working density, will be required. The air has been assumed to be compressed to a density of 60 atmospheres, and the contents of the reservoir to be 100 cubic feet. It was stated by the patentee, on exhibiting the model, that it would not be necessary to employ greater force to act on the pistons than about 50 lbs. on the square inch, (this being, he said, the pressure ordinarily used in the engines of steam locomotives,) which is rather more than 3 atmospheres, the latter being only 45 lbs. In my calculation, I propose, in order to simplify the figures, to employ the latter to represent the quantity of power required. Now, the power at starting being assumed to consist of 100 cubic feet of air compressed to a density of 60 atmospheres, and as the working-power is only required to be of the density of 3 atmospheres, it follows that a quantity of 2,000 cubic feet of air at the working density is contained in the reservoir, and as 1,440 cubic feet of such air will be required to propel the engine a distance of 1 mile, 2,000 feet will cause it to perform no greater distance than 1¼ mile. This result being nearly the same as that derived from the other method of calculation, it may, I submit, be taken to approximate to the truth.

The conclusion to which I come, then, is this: the engine (however meritorious in some respects) as projected, is inapplicable to railroad travelling, inasmuch as its power, (without requiring replenishment by a fresh charge of air,) is inadequate to perform efficiently, no greater distance than about 1¼ mile, (instead of 30 miles!) that its power cannot be sufficiently increased unless the capacity of the reservoir can be *very enormously enlarged*, or the air can be compressed in it to an *almost inconceivable degree*—either of which is impracticable; and that the project *must* therefore fail of accomplishing the purpose for which it is proposed.

In these remarks, Sir, I have not adverted to the defects in the *principle* of the engine, which is forcibly pointed out in the communications of your correspondents, Mr. W. Williams and A. W., appearing in your Magazine of last month, but I have taken the "statement of their case" as furnished by the projectors, and reasoned only from the data they have supplied me with, without considering whether some of the latter are well established; and even so, Sir, it seems the compression of the air is to form but a bubble, and a bubble that will burst. I have confessed, however, that its first appearance pleased me, and I was led, (I believe, like many others,) to be fascinated with a play of colouring it obtained, under the influence of a sunshine of popularity and patronage.

I am, Sir, obediently yours,

S. S.

Bedford-square.

ANHYDROUS STEAM.

A patent has been taken out lately for improvements in steam-engines, the principle of which, we understand, is founded on the use of anhydrous or dry steam. The inventor, Dr. Haycraft, has been favourably known to the scientific world by his researches into the capacities of the different gases for caloric, published by the Royal Society of Edinburgh in their *Transactions*, and referred to in the first volume of the *Transactions of the British Association*, chiefly in relation to the atomic theory.

It is some years since, if we mistake not, that Dr. Haycraft developed his theory on the use of anhydrous steam, which is founded on the fact that if water be deposited in the interior of a cylinder of a steam engine, it subsequently is evaporated every time the eduction valve is opened, and by its evaporation, tends constantly to cool down the cylinder in a ratio proportionate to the evaporation, and consequently to the quantity of water deposited in the cylinder. The theory itself is novel, and derives strong support from the facts of the case. It has been long known to practical men that if a boiler, in consequence of deficient steam room, or from other causes, primes considerably, a much increased consumption of fuel is required, while at the same time the power in the engine is diminished. To this cause may be attributed the enormous diminution of the power of locomotive engines in proportion to the fuel employed, as compared with other engines, where a sufficiency of steam room is attainable.

How far Dr. Haycraft has succeeded in his attempts to reduce his theory to practice remains to be seen. An experiment has been made which, though not complete, seems to promise fair. Mr. Penn, of Greenwich, has applied the invention to a small flour mill with the result, as we are informed, of a consumption of only 4 lbs. per horse-power per hour, and this, though the engine is low pressure, and the boiler a temporary one, with deficient steam room, and exposed to the weather.

The peculiar care taken in the Cornish engines to render the steam perfectly anhydrous, doubtless contributes, together with their great size, to render their proportional consumption of fuel so small. Their construction, unfortunately, renders them inapplicable for general purposes; but we see no reason why the same principle of using anhydrous steam should not be applied to engines of the ordinary construction.

We are informed that neither high pressure nor dry heat, as it is called, is used by the patentee to produce his results. Steam passes through vessels, or tubes, heated by fires, have been frequently used, and from obvious causes have signally failed.

PLAN FOR BEAUTIFYING GARDENS, ACCELERATING THE GROWTH OF PLANTS, AND INCREASING THEIR PRODUCTIVENESS.

Sir,—I feel inclined to offer a few suggestions for the improvement of gardens, to which, I flatter myself, you will not refuse a place in your treasury of knowledge, the *Mechanics' Magazine*.

The draining of land being decidedly beneficial for promoting vegetation, I beg to recommend draining-tiles for edging garden walks, and garden patches. The tiles should be made one foot long, and eight inches deep, with the ends halved out to fit into each other; they should be half an inch thick and the void between 1½ inch, making together 2½ inches. The top edge should be of a semi-circular shape, with the hollow edges open when fixed in the ground; the round edge to stand two inches above the path, which will be ornamented, and supersede the use of box-edging, which is a nuisance from the vermin it harbours. The walks will be dry and healthy, as the moisture will enter into the tile, being the most pervious part. A square corner will be required, which may be made of stone.

By the adoption of this plan it will furnish the means of laying down the requisite apparatus for conveying electricity to the soil, which has been satisfactorily proved to be so beneficial in expediting the growth of plants, and increasing the quantity of produce.* The

* Such was for a short time, and not long ago, the general opinion; but numerous experiments (said to be not less than from 1,000 to 1,200) made during the last year to test its correctness, in all parts of the kingdom, and under almost every possible variety of soil and climate, show it to be entirely fallacious. The "uniform result has been disappointment and failure."—We refer our correspondent to that excellent repository of information on all matters connected with electricity and magnetism, the *Electrical Magazine* for April, No. 12.—ED. M. M.

corners might be perforated with a square hole for receiving wooden poles ten feet long, with an eye on the top to elevate and secure the iron wire which is to conduct the electricity to the soil. The wire would pass through the drain, up the rod, and down the other side, enter the drain again, and pass round the patch in the same way. Attention will be required in laying out the beds south and north. The rods might be ornamented by rose or other trees being trained to them. This may be accomplished at a very small cost, and the result would be most satisfactory.

Ornament and utility will be combined in this arrangement.

I am, Sir, very respectfully yours,

JOHN HARRISON.

St. John Street, Devizes, Wiltshire.

P.S. Farms may be laid out in a similar way, and the drains applied to the same purpose; viz., draining the land, applying liquid manure to the crops, and conveying electricity to the soil.

## PUMP PERFORMANCES.

Sir,—I beg to offer a few remarks on the pump performance at Woolwich Dockyard, stated to be "extraordinary," though apparently a very humble affair indeed. According to Mr. Baddeley's statements, (vol. xli. p. 373,) it amounted to this,—that *one man raised* 3,433 lbs. *of water one foot high per minute, for fifteen minutes in succession*, or that fourteen men, seven of them working at a time, cleared a caissoon of 3,350 cubic feet of water, (62½ lbs. each,) in 74 minutes. But as the greatest altitude the water was raised was 13 feet, the calculation is considered fairly taken at an average of two-thirds of that altitude.

Now let us contrast the Dockyard's pump performance with the performance of the Fountain Pump, (noticed in vol. xxxix. p. 42,) *with which a man raised* 9,520 lbs. *of water one foot high per minute, for five minutes in succession*, and which has produced thousands of similar results since, and delivered more water by manual power than any other public pump in the city of Norwich. It has frequently delivered above 30 tons a day for street-watering alone, besides being constantly used for all purposes, both public and private. Yet its first connector stood that trying work for two whole years without faltering; when a new one was required, it was inserted in two hours' time, and it again performed the same work with half the labour of the old friction pump.

On the Norfolk Railway there is a fountain pump, worked sometimes by one man and sometimes by two men, which has delivered (to above three times the altitude of the Woolwich Dockyard pump) about 20 tons of water per hour, for six or seven hours daily, for many months.

No pump stands work so well as the Fountain pump when well carried out, and all insinuations to the contrary vanish before the following conclusive practical proofs:

Two treble acting Fountain pumps for horse-power, and one double acting one for steam-power, have been constantly at work for nine, twelve, and fourteen years for lifts of above 30, 40, and 90 feet altitude, and have not cost for each machine ten shillings per year for connectors, although their first cost exceeded 500*l*.

Gridiron valves (said to be lately patented) have been used in a fountain pump that delivers about 80 tons of water per hour, worked by two men at Horstead for dam work ever since 1832.

Mr. Baddeley, (vol. xxxvi. p. 331,) names a pump that cannot be equalled by any other pump till a man (of ordinary strength, of course) can raise 20,000 lbs. of water one foot high in a minute. And Mr. Ewbank (in his book, p. 155) states that a man raised 63,000 lbs. of water 1 foot high in a minute. Yet it is a thousand to one that either of these gentlemen ever saw a man raise even so much as 10,500 lbs. of water one foot high in a minute. But when speaking of height, it should always be calculated from the surface of the water of the source to the top of the delivery. As Mr. Baddeley delights in pumps, suppose we enquire how eminent men estimated their importance and calculated their results, and what they considered to be the maintaining power of a man.

Dr. Young says the quantity of water actually raised by any machine seldom exceeds half the power consumed after overcoming friction, &c., but that with a good friction pump, when in its best

state, or a mercurial pump, a man could raise from 9,000 lbs. to 10,000 lbs. of water one foot in a minute. Now with a Fountain pump a man can raise 9,000 lbs. of water one foot high *in half a minute*.

Dr. Desaguliers and Dr. Hutton both took great pains to guard the public against impositions; and they stated that the full average maintaining power of a man, whether to draw, push, work with a lever, or turn a crank, only amounted to the raising of 5,000 lbs. one foot high per minute, though from the defects of pumps they would never nearly equal that effect, and to exceed it was impossible.

De la Hire and Regnier give a lower result.

Mr. Smeaton made friction pumps in the best style possible, and understood them well, but could never find mens' strength to equal the above effect, except when working in haste or distress for a few minutes. (His standard is 3,750 lbs.)

However, since the art of raising water has been improved, a man with ordinary exertion delivers from 6,000 lbs. to 8,000 lbs. one foot high per minute.

Twenty-four men working in pairs, with Fountain pumps, would discharge from a line-of-battle ship 13,440 lbs., or 6 tons of water in one minute, and lift the whole 25 feet. These simple machines, in oak or in iron, would cost under £300, and take up less room than the men would, whilst all their top parts, brass-works, &c., could be removed and replaced in five minutes. Forty-eight men with chain pumps could not perform the same work as performed by the *twenty-four* with Fountain pumps.

If fair public trials were made with the Fountain pumps and the chain pumps, John Bull's eyes must open, and the disposers of the public money might take Sir Robert Peel's advice, and buy the best pump at the cheapest market.

There is not at this time a good fire engine upon a large scale in the whole world. And notwithstanding so many small engines have been sent to Norwich from London and elsewhere, in no case of fire has one been successful, whilst the Portable Fountain Fire-engine has never once failed. I give the following recent instance of its having saved large and valuable premises about four miles from Norwich, from the *Norfolk Chronicle* of July 5th, 1845:—

"On Wednesday night, Stoke Mustard, Starch, and Flour Mills being on fire, the Norwich Union and Corporation engines were sent off in great haste; but when half-way on the road, information was received that the fire was got under. Fortunately one of Mr. Shalder's admirable small engines was *on the premises*, which being brought to bear immediately on the blaze, the fire was speedily extinguished; but not till part of the flooring was burnt, and a quantity of wheat in the granary injured."

People should praise the bridge that carries them safe over, and what is useful ought to be made known. Sheriff Colman, proprietor of Stoke Mills, purchased the engine through the recommendation of Alderman Butcher, whose own premises had been preserved by the portable engine. (See *Mech. Mag.*, vol. xli. p. 328.)

Yours truly,

W. SHALDERS.

Bank-place, Norwich, March 18th, 1846.

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## THE GUTTA PERCHA PATENTS. NO. IV.

CHARLES KEENE, OF SUSSEX-PLACE, REGENT'S-PARK, ESQ., *for improvements in Boots, Shoes, Gaiters, Overalls, and other like articles of apparel.* Patent dated May 29, 1845; Specification enrolled, November 29, 1845.

My improvements in boots, shoes, gaiters, overalls, and other like articles of apparel, consist in rendering the same more or less weather and water-proof, and more easy of wear, by the application to the same, or the making of the same, in whole or in part of the substance recently imported from the East Indies, called gutta percha.

*First.*—I coat the pieces of leather, or other material, of which the boots, shoes, gaiters, overalls, or other articles of apparel, are made, and either on one or both sides, with a solution of gutta percha, or a solution of gutta percha mixed with a portion or portions of caoutchouc, or sulphur, or colouring matter, or any other substance or thing which may be calculated to improve the quality of the said solution as directed and explained in the specification of certain letters patent, of date 11th March, 1845, granted to Richard Archibald Brooman, for "certain improvements in the preparation and application of artificial fuels, mastics, and cements;" and this I do either once, twice, or oftener, according to the thickness of the solution, and the thickness desired to be given to the coating; and sometimes, instead of so coating the whole of the said pieces, I coat those pieces which are likely to be most exposed to the weather and wet,

as for example; the outer sole and upper leathers only.

*Second.*—I protect in like manner the said pieces of leather, or other material, some or all of them by covering the same, either on one or both sides, with a layer or layers of gutta percha in the plastic state, or of gutta percha combined in the said plastic state, with a portion or portions of caoutchouc, or sulphur, or colouring matter, or of French chalk, or other soft powder, as directed in the aforesaid specification of the patent of Richard Archibald Brooman, applying the said layer or layers by the means and in the mode also described in the said specification.

*Third.*—Instead of either coating or covering, as aforesaid, the materials of which the boots and other articles before-mentioned are made, I sometimes interpose between the same or certain portions of the same; as, for example, between the inner and outer soles, or between the upper leathers and lining pieces of gutta percha in any of the sheet states in which it is manufactured under the said patent of Richard Archibald Brooman.

*Fourth.*—I manufacture boots, shoes, gaiters, overalls, and other like articles, in whole, or in part, of a compound fabric, formed as described by the specification of the said Richard Archibald Brooman, by adding to gutta percha while in the kneading machine (whether previously combined, or not combined, with caoutchouc or sulphur, or colouring matter, or French chalk, or other soft powder, as aforesaid) a portion of leather, dust, or hair, or bristles, or ground cork, or woollen shearings, or other membranous, or fibrous substance, in a finely comminuted state.

*Fifth.*—I also manufacture boots, shoes, gaiters, and other like articles in whole or in part of a certain other fabric which is directed in the specification of the said Richard Archibald Brooman, to be formed by saturating a bat or fleece of cotton wool, or other fibrous material, with a solution of gutta percha, or a mixed solution of gutta percha, and caoutchouc; preferring, however, for the purpose of this branch of my invention, such bats or fleeces as have been saturated with a solution containing in it a portion more or less of sulphur and of some colouring matter.

*Sixth.*—I make boots and shoes, and the other articles aforesaid, of gutta percha, or of a mixture of gutta percha and caoutchouc, either sulphurized or not sulphurized, all in one piece without either sewing or stitching, as usual, by casting the same in cored moulds, made of the required form of the boot, shoe, or other article. I either fill the mould with the material in a state of hot solution, and leave it to cool, or I fill it with the material in a granular state, heat the mould till its contents become in a pulpy state, and then set it to cool. I sometimes use a single matrix only, and cause the material in a sheet or in a plastic state to assume the shape of that matrix by forcing it into the recesses thereof by means of the pressure of water or air, and sometimes, in order to give greater springiness to the boot or shoe or other article, instead of casting it all in one piece, I cast it in two or more pieces; as for example, I cast the front part in one piece and the heel or back part in another piece, and unite the two parts by means of an interposed piece or pieces of leather or of gutta percha in the sheet and sulphurized state, or some other like flexible material.

*Seventh.*—Instead of uniting the different parts of which boots and shoes, and other articles aforesaid, are made, by stitching or sewing, as usual, whenever any two of these parts, or any one or two parts consist or consists of gutta percha, or of a mixture of gutta percha and caoutchouc in any of the sheet states aforesaid, I pass a hot iron over the joint or joints, which causes the two surfaces to adhere firmly together.

*Eighth.*—I take boots, shoes, gaiters, overalls, and other like articles as they are now ordinarily made of unsulphurized caoutchouc and greatly improve the same in point of smoothness of texture and capability of resisting variations of temperature by exposing them for from thirty to sixty minutes to the fumes of sulphur in a close vessel heated to a temperature of 210 to 250 degrees more or less, or immersing them for the same length of time in a bath of melted sulphur. In either case, in order to prevent the articles from sticking to one another, they should be done over with a paste made of French chalk, flour and water, and that paste allowed to dry before subjecting them to the action of the sulphur. Boots, shoes, and other articles made in whole, or in part of unsulphurized gutta percha, may be treated in the same way, but I prefer incorporating the sulphur in the first instance with the gutta percha when it is in the state of solution, or in the plastic state, or in any of the other states of preparation and co m bination aforesaid.

*Lastly.*—I improve the shoes of horses by laying upon and securing to the upper part of the same, a sheet, or layer of sulphurized gutta percha, or of sulphurized caoutchouc, or by making the same wholly of either of the said materials. In the former case, the sheet or layer of sulphurized gutta percha, and sulphurized caoutchouc, may be either attached to the shoe by rivets before it is applied to the foot, or it may be laid loosely between the shoe and foot when the horse is being shod, and be made fast by passing the

shoe-nails through it. It affords a soft and yet firm footing to the animal, and resists, without injury to its shape, very high degrees of heat and pressure.

## EXPERIMENTS UPON THE GYMNOTUS ELECTRICUS. BY MM. D. DE MIRANDA AND G. M. PACI, COMMUNICATED TO THE "SCIENTIFIC CONGRESS OF NAPLES," SEPTEMBER, 1845. FROM "ARCHIVES DE L'ELECTRICITE." VOL. V. P. 496, NO. XX., JANUARY, 1846, AS TRANSLATED IN MR. WALKER'S "ELECTRICAL MAGAZINE" FOR APRIL.

The gymnotus, upon which the following experiments were made, arrived at Naples from Rio Janeiro, August 15, 1844. It is placed in a large metal trough filled with water; its food consists of frogs and small fish; when, for example, it wishes to eat a frog, it directs itself towards it; and, when it reaches to the distance of about a foot, it stops and looks at it. The latter becomes motionless, and, so to speak, paralysed, until it floats over the water without moving; the gymnotus then seizes it, and feeds upon it.

It is remarkable that this effect is produced upon a single frog among all those that are swimming round the gymnotus; and it is not always upon the one that is nearest to it.

The gymnotus has been sometimes seen toact, as Williamson describes it; namely, to kill frogs or fish, as if with indifference, and without afterwards feeding upon them. This fact would seem to indicate that the only object which the animal has in view, in certain cases, is to discharge its electricity when it feels a need of doing so.

At the period of cold weather, the gymnotus was transferred to a wooden box, placed in one of the chambers of the royal apartments. This apartment, although exposed to the south, was very rarely opened during the winter; and then only for the few moments necessary for changing the air.

The water in which the animal naturally lives is muddy. In endeavouring to reproduce this circumstance, the water of the trough was entirely changed only once a fortnight; in the intervals it was partially filled with common warm water. Thanks to these precautions, the gymnotus, which was originally from a warm climate, and accustomed to live in water at 26° cent. (80° Fahr.) passed a winter easily in a bath at the temperature of 22° to 24°, and in an atmosphere of 24° to 25°. It attained the length of 3 ft. 4 in. The largest gymnoti that Humboldt observed at Cano de Bera, in South America, were 5 ft. 3 in.

Our attention is first directed to the phenomena of the shock. The shock is felt most powerfully when the animal is touched with both hands on two different parts of its body. In this case it is felt in the arms and in the breast, which form an arc of communication; but it is also felt even when the animal is touched with a single hand; it is then felt in the arm that is in contact with the animal, and in the correspondent articulations; the discharge traverses the limbs, the ground, and the water of the bath. If a chain of several persons is formed they all feel the shock at the same time, whatever be the manner by which the discharge is obtained; namely, whether the first and the last person of the chain touch the animal at the same time, or one person alone places himself in contact with it. In the latter case, we have seen the shock communicated to four persons. Two persons having then touched the gymnotus, one towards the head, and the other towards the tail, one only felt the shock,—the one who touched the tail; at another time it was the one who touched the head: again at other times both felt it, and more powerful (as they fancied) than when either of them had alone felt it.

The gymnotus does not make the shock to be felt every time it is touched. In order to obtain it, it is sometimes necessary to irritate the animal, even to squeeze it, especially near the electric organ,—a fact which proves, as Bancroft says, that its electromotive apparatus is not put in action except by the concurrence of its own will. Sometimes, when it has been irritated, the shocks that it gives are so energetic, that they surpass those of the strongest piles, and they who receive them feel their effects for a considerable time; they really become painful when they are repeated. We are aware that they are more or less energetic according to the degree of vigour and of the excitation of the animal. They are also more intense before its meal than when it had eaten. Their intensity diminishes in proportion as the animal is exhausted; so that when it has been excited for some time, it is necessary to leave it at rest, in order that it may recover its strength.

It might be said that the gymnotus is endowed with an occult sense, which informs it of the degree of vigour of the person or animal that is to receive the shock, so that it may regulate the intensity of its discharge. This fact agrees with De Humboldt's observations, who says that the gymnoti know how to choose in large animals for the particular place that is most sensiive to the shock.

A workman of the king's household, who was suffering with a very violent pain of the right shoulder and the right arm, and being almost incapable of attending to any duty,

was entirely restored after receiving three or four shocks of mean strength. The same was the case with a servant of the royal apartment, who was suffering with a rheumatic affection.

When the gymnotus was transferred to a small tub, the water of which was gradually raised to 28° cent. (82° Fah.,) the shocks that it gave were stronger and more frequent in proportion as the temperature of the water increased,—a fact which confirms the account of travellers on the greater intensity of the phenomena produced by this fish in its native country, and in a warmer climate. We cannot, however, say, with Becquérel, that there is any analogy between the calorific action of the electric discharge, and the phenomena of phosphorescence; we should rather say, with Professor Matteucci, of Pisa, that the greater activity of the respiration and circulation of the animal, while living in warm water, has a direct influence over the nervous system, and hence over the electric functions.

The prepared frog contracts strongly, when the gymnotus discharges itself even in a great mass of water, and at a considerable distance. It is by a similar effect that the animal renders itself master of the fishes, upon which it feeds. We have more than once observed the following fact:—when a fish is held in the pond, and made to move slowly through the water, in order that the gymnotus may follow it, the latter, when it becomes tired of this amusement, would discharge its shock and seize the fish, of which we were obliged to lose our hold on account of the violence of the shock.

*(To be Concluded in our next.)*

## NOTES AND NOTICES.

*Improved Railway Whistle.* — The *Censeur de Lyon* proposes as an improvement in railway whistles (which as now made, stun passengers with their frightful noise—while the driver of an approaching train cannot hear them when the wind is unfavourable,) to attach to them by a swivel connection, a kind of speaking-trumpet, by the turning of which the sound can be conveyed in any direction, and to a much greater distance than by the present mode.

*A Musical Bed.*—The last novelty from Germany is a musical bed which receives the weary body and immediately "laps it in Elysium." It is an invention of a mechanic in Bohemia, and is so constructed that by means of hidden mechanism, a pressure upon the bed causes a soft and gentle air of Auber to be played, which continues long enough to lull the most wakeful to sleep. At the head is a clock, the hand of which being placed at the hour the sleeper wishes to rise, when the time arrives, the bed plays a march of Spontoni, with drums and cymbals, and, in short, with noise enough to rouse the seven sleepers.

*Squaring the Circle.*—The following paragraph appears in the *Daily News*:—"A party is said to have died, leaving the sum of 100,000*l.* in trust, to the then Lord Chancellor, for the benefit of the individual who should clearly demonstrate the square of the circle; the interest, until the condition of the will is complied with, to be paid to one of the colleges at Cambridge,—it is believed St. John's." We should be sorry to believe this statement true, since its inevitable tendency, if true, must be to stimulate ingenious, but half-informed men, to a vast quantity of utterly useless labour. All that can possibly be done, beyond mere adding of figures to figures, has been done already. The prize is one never to be won, and the bequest such, therefore, as could have no effect whatever in law.

*Copper Mines in Canada.*—Some of the British officers in Canada have lately made an important discovery of some of the richest copper mines in the world. This discovery has created great excitement. Some of the officers *en route* to England, will carry with them specimens of the ore; and, among them, one piece weighing 2,200 lbs. The ore is very rich, yielding, as we learn, 72 per cent. of pure copper. Part of the copper was taken from the bed of a river, and some broken off from a cliff on the banks. The latter is six feet long, four broad, and six inches thick."—*Cambrian.*

*Indian Cobalt.*—A new field of cobalt has been discovered in the East Indies, in the mountainous country of Rajpootanah—a district already celebrated for its mineral wealth, and principally for its coppers in the state of sulphur and sulphate, and its alums. It is in one of the copper mines that this cobalt is found—lying abundantly in the state of sulphur of great purity. It is accompanied by only one other substance—pyrites of iron, highly magnetic, and easily separated from it by a loadstone of moderate power. These it contains in the proportion of 9·22 per cent. The remainder of the mineral consists wholly of pyrites of cobalt, of the specific weight of 5·45, and composition following:—Cobalt 64·64; sulphur, 35·36. The Indian jewellers already use it advantageously for colouring gold with a rose tint of great delicacy.—*Athenæum.*

*Iron Market-house,*—The Glasgow papers describe an iron market-house for Honduras, that has just been completed by Messrs. Edington, of Glasgow. It "measures 108 feet long and 60 feet wide, and is surrounded by a colonnade or verandah 12 feet wide, supported by handsome fluted columns. The interior or main building contains numerous stalls for the sale of the various market commodities, and is ventilated by means of jalousie blades, fixed in the manner of Venetian blinds. There is besides a ventilator on the top, that nothing may be wanting to encourage a delicious coolness in the hot climate for which it is intended."

*New Wind Power.*—A machinist at Cabotville, Mass., has just erected a shop at that place, the machinery of which is propelled by wind, in a somewhat novel manner. A large wheel, measuring 14 feet in diameter, furnished with wooden sails, or floats, is placed upon a perpendicular shaft, on each side of which, in a room below, is an invention similar to window shutters, which, when opened, causes the wind to rush in, and rising sets the sails and wheel in motion, and produces a velocity equal to that of any water-wheel. We have seen a beautiful model of this wind-wheel at the shop of the truly scientific machinist, Mr. A. French, 63, Centre-street.—*Boston News.*

*Iron Ship Building.*—Mr. J. Watchman, of Baltimore, M.D., is stated to have invented a machine for bending iron plates for ship building. It is formed by a combination of screws, the head of which has a socket-joint so that it may be turned to suit any curve. The lower bed of screws is first arranged to suit the pattern wanted, and then the upper ones run down or up to match. The upper plate with screws is raised, and the sheet heated and laid in, and is pressed between the two until cold, when it is ready for use.

*Errata.*—In Colonel Jackson's article in last Number, p. 247, col. 1, line 21 from bottom, for "patron," read patrons; p. 248, col. 1, line 2, between the words "not" and "consider," insert the word *but*.

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# CAPTAIN ERICSSON'S LATEST IMPROVEMENTS IN THE STEAM ENGINE AND STEAM NAVIGATION.

Fig. 5.

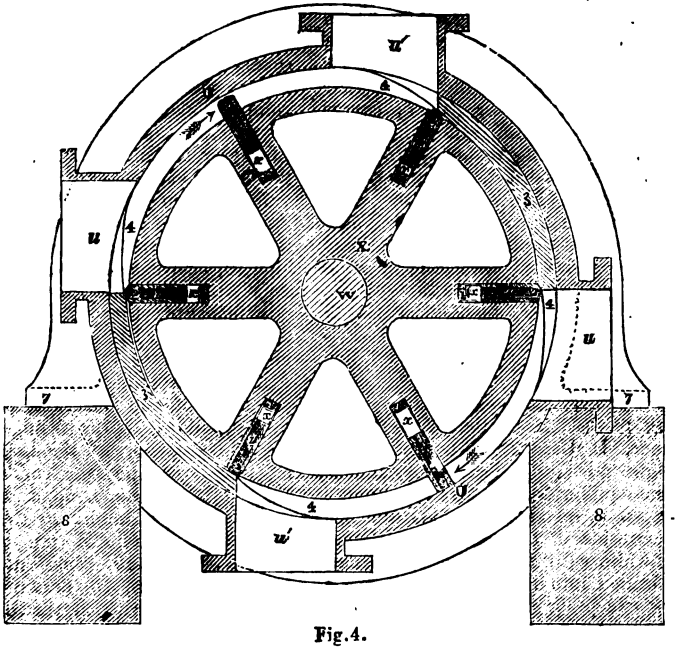
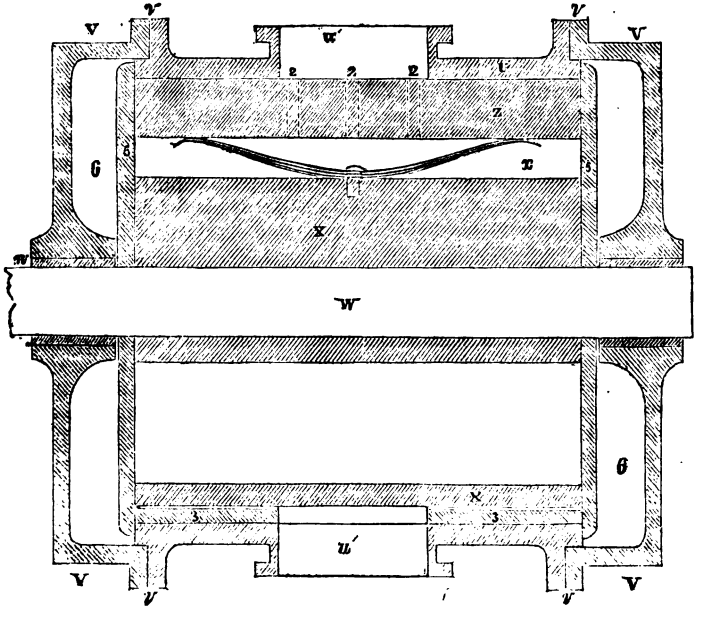



Fig. 4.



## CAPTAIN ERICSSON'S LATEST IMPROVEMENTS IN THE STEAM ENGINE AND STEAM NAVIGATION.

(Concluded from page 259.)

FIGURE 4 represents a longitudinal section; fig. 5, a transverse section; fig. 6, a side elevation; and fig. 7, an end view of the hydrostatic rotator; U U, a cylinder made of cast-iron or composition metal, provided with four apertures, *u u u' u'*; V V, covers bolted to the ends of said cylinders at *v v v v*; W, an axis revolving in bearings, *w w*, formed in the centres of the covers, V V; X, a wheel or drum attached to the axis W, composed of a thick rim and six solid spokes, extending the whole width of the rim; *x x x x x x*, parallel cavities in said spokes; Z $Z^1$ $Z^2$ $Z^3$ $Z^4$ $Z^5$, metallic wings or sliding pieces, made to fit the said cavities with great accuracy; 1 1 1 1 1 1, springs inserted in bottom of said cavities for the purpose of pressing these sliding pieces against the inside of the cylinder, U U; 2 2 2 2 2 2, holes through said sliding-pieces for establishing an equilibrium of pressure around them. 3 3, metallic segments attached to the inside of the cylinder, U U, of equal width with the rim of the drum, and formed into inclined planes at 4 4 4' 4', excepting at the apertures *u u u' u'*, where they terminate abruptly as shown in the engraving; 5 5, circular discs firmly attached to the ends of the drum, X, at a distance equal to the length of the cylinder, U U; 6 6, cavities formed between the covers, V V, and discs, 5 5; 7 7, lugs cast on the covers, V, V, and bolted to the timbers, 8 8, for supporting the machine. Fig. 8, represents a stern view; and figures 9 and $9^a$, longitudinal sections of a steam-vessel, giving a general view of the before-described improvements, the same letters of reference being used in this figure to represent the parts corresponding with those in the figures before described. 9, is a hollow shaft attached to the axis, W, of the hydrostatic rotator; 10, propeller-shaft, passing through a stuffing-box 10', in the stern, provided with a feather, 11, made to fit a corresponding groove within the hollow shaft, 9; 12, a grooved ring attached to the propeller-shaft for moving the same in and out in the hollow shaft by means of a lever-fork, or other usual contrivance; 13, side-view of a spiral propeller; 14, an elongation of the nave thereof, which elongation, as well as the nave itself, is provided with a square hole in the centre, corresponding to a square at the end of the propeller-shaft; 15, an arm made of wrought iron, or composition metal, attached to the shaft or axis, 16, which shaft also passes through a stuffing-box, 16', in the stern, the lower end of said arm being provided with an eye or bearing, by which the projecting nave of the propeller is held, and in which it may revolve; 17 and 18, bearings attached to the side of the stern-post of the vessel for the purpose of supporting the propeller-shaft and the shaft, 16; 19, a toothed quadrant attached to the inner end of said shaft; 20, a tangent screw working in the teeth of said quadrant, and moved by the handle, 21, for raising or lowering the propeller by the before-named metallic arm; 22, the rudder; 23, a slit cut in the same, opposite the propeller shaft, for admitting the requisite angular movement of the rudder in steering. Fig. 10, represents an end-view of the arm, 15, drawn to an enlarged scale, in which the bearing for holding the elongated nave of the propeller will be more clearly seen. Fig. 11, is a side view of the said elongated nave; and fig. 12 a side-view of the square end of the propeller-shaft, both drawn to an enlarged scale, the hole in the nave being indicated by dotted lines. Fig. 13, is a sectional plan of the extreme point of the stern of the vessel, through the centre line of the propeller-shaft; 18, is the bearing attached to the side of the stern-post for supporting the shaft; 22, rudder; 23, a slit cut in the same, opposite the propeller-shaft, in order to admit the necessary angular motion being given to the rudder.

Having thus particularly described the said improvements in the steam engine, and its application to navigation, I will now proceed to explain the manner in which the same are to be put into operation. In starting the engine, the throttle-valve, *e*, and the stop-cock, *g*, should be kept open while steam is admitted from the boiler through the steam pipes, E and G. But as soon as motion has thereby been obtained in the engine in

Fig. 7.

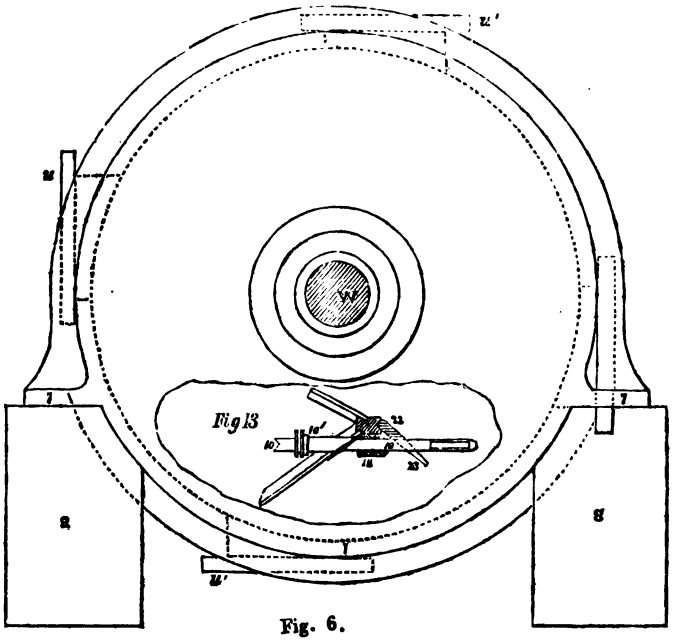
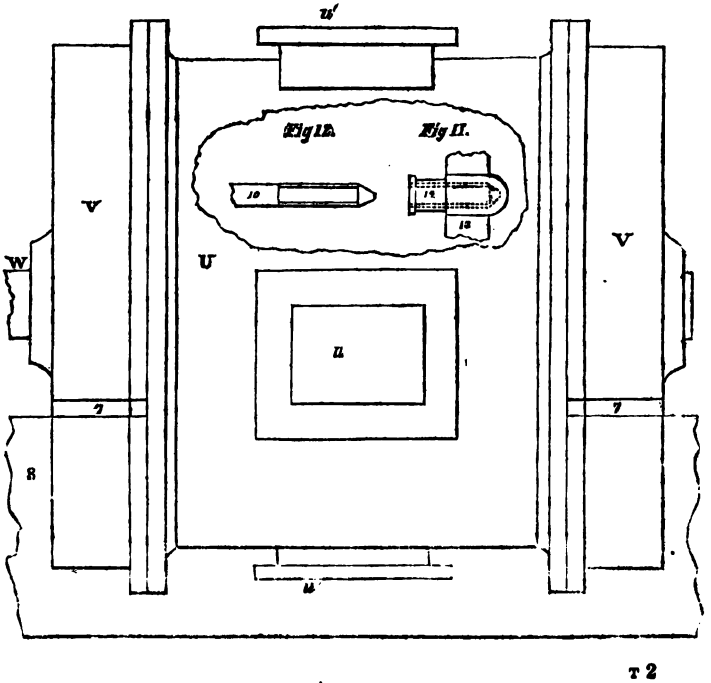



Fig. 6.



the ordinary manner, the stop-cock, *g*, should be shut, as shown in the drawing, and the throttle, *e*, should be allowed to open and close in the manner before described for the purpose of working the steam expansively in the cylinder, B. It will now be seen that the pressure of the steam on the right side of the piston, *b*, will by means of the piston-rod and the connecting-rod, *a'''*, and the cranks, *a'*, give a left-handed movement to the crank-shaft, A, which movement will cause the crank, *a*, to pass its centre with an upward movement, and thus attain a position which will enable the piston, *c*, to exert its force in giving also a left-handed movement to the crank-shaft, A. It is evident that when the piston, *b*, has arrived at the termination of the stroke, the piston, *c*, is at half-stroke. The slide-valve, F, being now shut, the steam contained within the cylinder, C, on the right side of its piston, will by its expansive force cause the piston, *c*, to continue its movement to the termination of its stroke, whilst the due action of the slide, D, will, in the meantime, have relieved the pressure on the right of the piston, *b*, by admitting the steam into the condenser through the pipe, *d*. It is also evident from the right angular position of the cranks, *a a'*, that at the moment the piston, *c*, has arrived at the termination of its stroke, the piston, *b*, will again have assumed the position marked in the engraving.

At this moment the slide valve, F, is opened, and the pressure of the steam in the cylinder, B, on the left side of the piston *b*, will give *c* the necessary retrograde movement to the right, whilst the slide, D', will have relieved the pressure on the other side of the piston by opening the necessary communication with the condenser. Thus it will be seen, that the steam admitted into the cylinder, B, by the main steam-pipe E, will, during half the stroke of the piston, *b*, exert its entire force thereon, but during the remaining half of the stroke, whilst the throttle, *e*, is kept shut, the steam will act simultaneously on both pistons, *c* and *b*, and that during the latter half stroke of the piston, *c*, while the slide valve, F, is kept shut, the steam in the cylinder, C, obtained solely from the cylinder, B, will cause the piston, *c*, to complete the stroke. In this manner the steam actuating the engine may be worked highly expansively, and still a sufficiently regular force will be imparted to the crank-shaft by the pistons, and a great saving of steam and fuel be thus effected. It should here be particularly noticed, that if steam of considerable pressure is admitted into the cylinder B, it will be well to make the cylinder, C, of greater capacity than the cylinder B, in order to obtain a more equable force from each engine. In applying this engine to ordinary steam vessels with paddle wheels, the crank shaft, A A, is extended as shown by the dotted line, A' A', and the paddle wheels are applied at the extremities as usual; but when applied for the purpose of giving motion to the hydrostatic rotator before described, the crank shaft, A A, is cut short, as shown in the engraving, and the piston rods of the pistons, *c* and *b*, extended for working the double-acting force pumps, H and J. It will be seen by the position of their valves, that these pumps will draw in any fluid admitted into the pipe, K, and force it into the receivers, L, and pipe M.

I proceed now to describe the manner in which the centrifugal apparatus and heater operate in connection with the steam boiler. In first lighting the fire and raising the steam, the damper, *n''*, (Fig. 9*a*,) should be kept open, in order that the natural draft in the chimney may be employed for supporting combustion in the furnaces; but as soon as the steam is raised, and the engine put in operation, this damper should be closed, and the wheel of the centrifugal apparatus made to revolve rapidly in the direction of the arrow at O, which may be done, either by bands and pulleys connected with the engine-shaft in the usual manner, or by a separate small steam engine, the effect of which motion will be to draw the hot air out of the flues of the boiler, and force the same through the spaces between the tubes of the heater.

It will now be seen, that since the cold water from the force pump in its passage to the boiler, as before described, is made to enter the small tubes at the upper part of the heater this water will become gradually heated in descending the series of tubes, and that thereby the hottest part of the air from the centrifugal apparatus will come in contact with the warmest part of the tubes of the heater, whilst the air in its ascent between these tubes, as

Fig. 9.

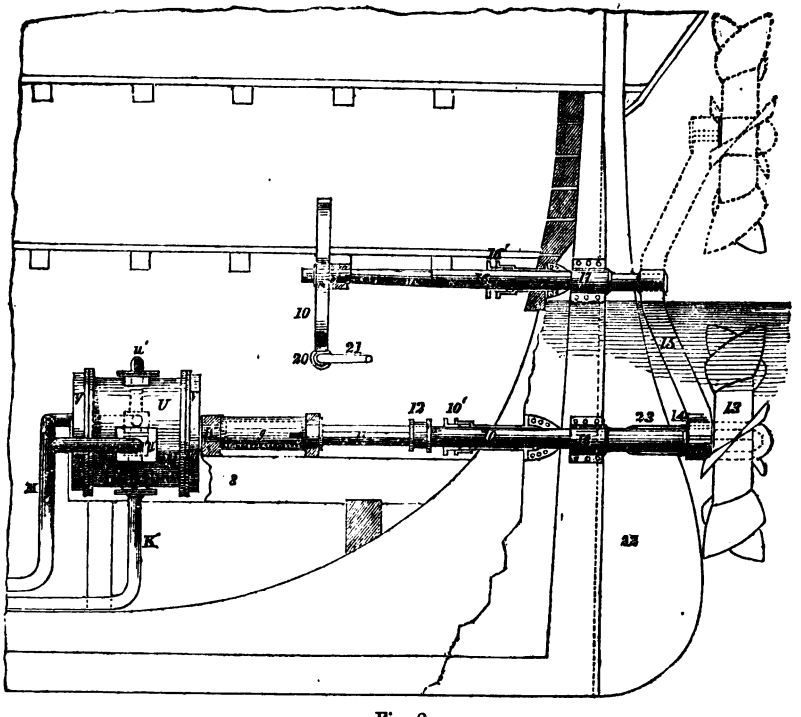



Fig. 8.

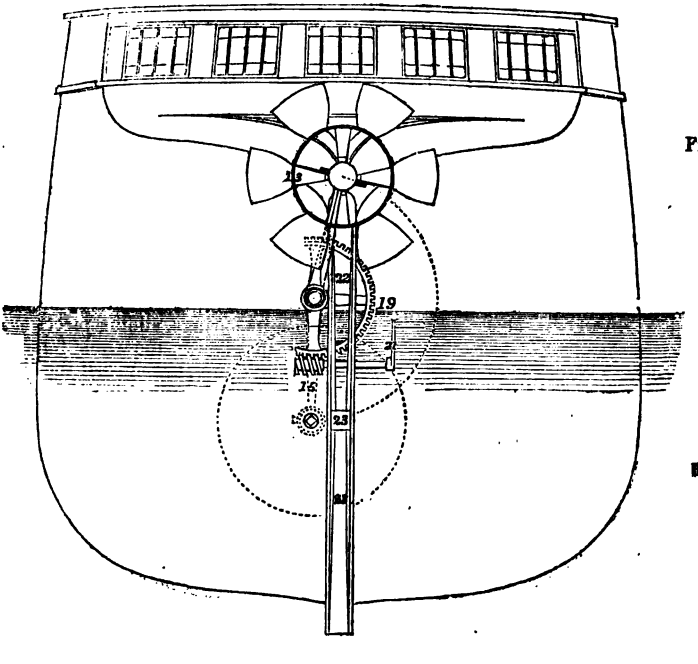
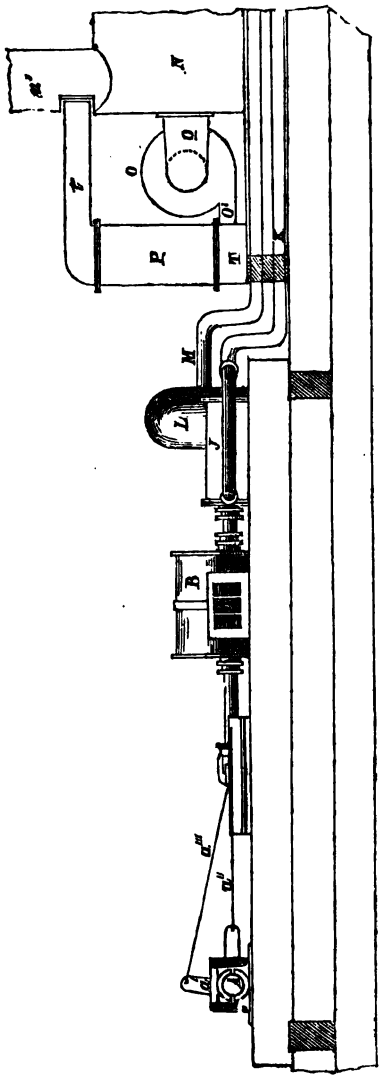



Fig. 10.

Fig. 9a.



it gradually cools, will come in contact with the coldest part of said tubes at the upper part of the heater, and thus the heat will be effectually taken up before entering the chimney through the passage *t*, and a great saving of fuel be effected.

I have next to notice the operation of the hydrostatic rotator. By reference to fig. 9, it will be seen, that the pipe, M, which receives the fluid from the force pumps, and in which the fluid is kept under a heavy hydrostatic pressure, communicates with the apertures, *u u*, of the rotator, and also that the pipe, K, through which the fluid is drawn into the pumps, and in which the fluid is not kept under pressure, communicates with the apertures, *u' u'*. By inspecting the transverse section represented in fig. 5, it will be seen that the fluid entering at the two apertures, *u u*, will exert equal force in precisely opposite directions, and that therefore its hydrostatic pressure, however great, being thus perfectly balanced, will not cause any friction in the axis, W. It will also be seen, that the hydrostatic pressure against the sliding piece, *z*, acts in opposite directions to the hydrostatic pressure exerted against the sliding-piece, $z^3$, thus imparting a rotary movement to the wheel, X, proportionate to the force of the hydrostatic pressure under which the fluid is kept, and to the extent of the protruding surface of these sliding pieces beyond the circumference of the wheel. By further inspecting fig. 5, it will be seen, that during the rotation of the wheel, X, to the right, the sliding-pieces, $z^5$ and $z^2$ will advance down the inclined planes, 4 4, until they touch the inside circumference of the cylinder, U U, so that by the time the sliding-pieces, *z* and $z^3$ arrive at the apertures, *u' u'*, and begin to ascend the inclined planes, 4' 4', the said sliding-pieces, $z^5$ and $z^2$ are placed in positions to receive the force of the fluid, the remaining sliding pieces will move in like manner down these inclined planes in succession, and thus a constant rotation, with a uniform force, will be imparted to the wheel, X, by means of the hydrostatic pressure of the fluid forced through the pipe, M. It is particularly worthy of remark, that the axis, W, is not exposed to any pressure besides that produced by the weight or gravity of the wheel with its springs, sliding pieces and discs; and that hence, the whole force of the hydrostatic pressure against the sliding pieces, with the exception merely of their friction, is exerted in giving rotation to the said axis, W. It is also worthy of remark, that the hydrostatic rotator, whilst it may be made to revolve at a speed many times greater than that of the crank-shaft of the engine, may be placed in the very extreme part of the

...un of the ship, whilst the steam engine ...hich gives motion to the same is placed ...n the forward or middle part; there being no other connection between the two than the pipes, which may be placed in its very bottom, there is no machinery which will interfere in the least with any desirable arrangement in the vessel. I have to observe, that whenever it is desirable to turn the rotator at a velocity of two revolutions per second, the radial movement of the sliding pieces should not exceed one-thirtieth part of the diameter of the cylinder containing it.

It remains, lastly, to notice the manner of disengaging the propeller from the axis of the hydrostatic rotator, and of lifting or unshipping the same. The propeller shaft, 10, by means of the grooved ring, 12, and the forked lever as before described, is drawn into the hollow shaft, and thus withdrawn from the square hole in the nave of the propeller. The propeller being held by the eye, or bearing, in the lower part of the arm, 15, it will be lifted up by giving half a revolution to said arm by means of the toothed quadrant and the tangent screw before described. By reversing this operation, the propeller may be reshipped and connected to the propeller shaft.

And having now fully described the nature of the said invention, and in what manner the same is to be performed, I declare that I lay no claim to the pistons, cranks, rods, or other known parts in the steam engine before described. But what I do claim, is—*First*, the admitting the steam from the boiler into one cylinder only, and the working of the steam expansively in the said cylinder, together with the employing the steam to act simultaneously on both pistons during part of the stroke, as before described, by opening a communication alternately between the two cylinders, whilst at all times a vacuum is kept up in both cylinders on the opposite sides of each of the ...tons, to that on which the steam acts.

*Second*, the employing in the manner ...fore described of the heat which has ...therto been wasted in ordinary marine ...ilers.

*Third*, the application of force pumps ...a steam engine for forcing oil, water, ...other suitable fluid through pipes or ...her conductors into any apparatus ca...ble of imparting, by means of such fluid, rotary movement to a spiral propeller placed at the stern.

*Fourth*, the combination with force pumps attached to a steam engine of the hydrostatic rotator before described, for the purpose of giving motion to a spiral stern propeller.

*Fifth*, and lastly. I claim as my invention the disengaging the propeller from the propeller shaft, and the raising and lowering the same in the manner before described.

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## MISCELLANEA MATHEMATICA.—NO. X.

(Continued from page 236.)

### *Mathematics as a Branch of Professional Study.**

We have stated in our last article (page 233) our general views respecting the origin of the difficulties experienced by the young algebraist in his early studies. There is one other which we have implied rather than expressed—the continually recurring inquiry into the *utility* of the study. It wears to him the aspect of a system of ingenious trifling rather than of a practical pursuit; since he can find no case of a professional nature either in his usual books or in the oral instructions of his superior, to which his algebra can in any way be applied. We have alluded to the cause of this: that though pure algebra can be applied *directly* in professional inquiries, the cases are not pointed out in the books which he is likely to read, nor are those cases themselves so numerous as to render the formation of a good collection of examples an easy task.

The great value of algebra is, let him ever remember, not as a science *per se*, but as *an organ of future research*. Its great use is prospective; and with prospective reference, it is not only invaluable, but altogether indispensable. It will confer upon him a *power* of great magnitude in his professional studies;

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* The reader is requested to make the following corrections of our last Number of the Miscellanea:

Page 234, col. 2, line 15, for *algebraic equations*, read *algebraic expressions*.

Page 235, col. 2, line 8, for *intermediate*, read *indeterminate*.

Page 237, col. 1, lines 23, 25, for *their* read *his*.

Page 237, col. 2, line 24, for *redeem* read *reduce*.

though like the acquisition of a language, it can be of little real value to him beyond the uses which he shall afterwards make of it. The most ample acquirements of a purely algebraic character, we should deem to be idly made by the engineer or architect, were his mathematical studies not to take a wide range beyond that subject, and his applications of it to be ramified into every department of his profession.

We have already intimated that algebra and geometry are almost alike repulsive upon the first glance; although in the two sciences the causes of the dislike are not precisely the same. On the first head we have already spoken—we now proceed to the second.

It very naturally occurs to the student to procure a copy of *Simson's Euclid;* and, of course, he reads the definitions, axioms, postulates, and a few of the earlier propositions of the first book, with the zeal of absolute determination to become a geometer. He pauses to reflect upon his progress, and asks himself what he has learnt that he did not know before? His mind, his eye, and his hand have already been familiar with the circle and the triangle; and he had, or thinks he had, acquired some little acquaintance with the geometrical properties of the simpler classes of figures. Undoubtedly those properties of figures which are intellectually true, are also visually true; and tolerably obvious properties of the figures most commonly used will be suggested to the practised eye by a survey of the diagram, and verified by actual measurement in any selected example of that class. By varying the related parts of the figure, and finding the law to hold in all the cases that he shall have tried, he is not only constrained to admit, but considers it absolutely proved, that the properties in question are universally true. Those students, therefore, who have been at all employed on plan drawing, (if not otherwise *previously* disciplined,) are invariably self-educated in a mode of research that is *directly opposed* in its spirit and character, to the true mental geometry of Euclid. We regret to say that it is to be found in the school of "*Practical Geometers*" of England; and we are ashamed to add that it is found there *only*. One of our own correspondents has even urged that the "eye is a good geometer, when properly taught": and in this sense the phrase is intelligible; although the doctrine contained in it is most pernicious as a principle, in reference to a professional course of study.

The retrospective survey of his progress to which we have alluded, will inevitably have led the student to institute a very unsafe criterion of the value of the course of rational geometry, which he finds in Euclid's Elements. Because he finds only a formal, and as he thinks, complicated, proof of propositions which he is not only prepared to admit, but considers to be so plain as to need no proof, he is led to conclude at once, that the geometry of Euclid is only a system of elaborate trivialities, fit at best to occupy the time and exercise the ingenuity of college idlers, who have no serious business to perform in life. He soon learns to cavil with the fundamental principles of the science. He asks if a line *can be drawn* which shall have no breadth, or a point *can be marked* which shall have no magnitude—or a surface *can be made* which has no thickness? He asks, why cannot a distance be *taken in the compasses*, and set off in a given direction, instead of the "round-about" processes of the constructions in Euclid's second and third propositions? Why there should be the parade of unintelligible reasoning, by which the fourth and fifth propositions are established, when "everybody" can see with a single glance that *they must be true?* Thus he proceeds, guided by what he is pleased to call "common sense," till he arrives at what to him appears a very conclusive proof that the study of rational geometry is little, if anything, better than "sheer nonsense."

This is the starting point of the most fatal course of thinking in respect of geometry that the student can pursue. It deprives the science of its peculiar characteristics *as a science*, and degrades the mental system into a merely experimental one. It shuts out all chance of the *discovery* of the more recondite, and often of the more practically important truths of geometry; whilst it places even the earlier and more obvious ones upon a basis which to every reflecting person is one of the most unsatisfactory character.

We entreat of such readers and such thinkers an attentive consideration of the remarks that we are about to offer; and in order to render our remarks as intelligible as possible, we shall either enforce them by illustration, or actually found them upon particular examples.

Let us suppose, then, that it is required (*Euc.* iv. 11) to inscribe a regular pentagon in a given circle, and that the experimental geometer, to whom we have referred, is familiar with the actual mode of construction. He has verified by actually stepping the compasses from angle to angle, the truth of that construction in a great number of cases; and never having found it fail, he does not entertain the least doubt of its correctness. These experiments are *his* evidence of its truth. Let now another and a rational geometer state his grounds of belief of the same truth. The two conclusions agree as to the fact; but the amount of certainty is remarkably contrasted. The rational geometer is led by irresistible evidence to the conclusion that such a course of operations as is prescribed, cannot, under any circumstances, *but produce* a regular pentagon; whilst the experimental geometer concludes that this course will *probably* produce it in any case, since it has produced that figure in every one of the cases which he has tried. The evidence of the rational geometer is *absolute*, whilst that of the experimental geometer is only a *varying but small amount of probability*. We can imagine a geometer of the practical class tossing his head proudly, and with a scornful contempt for the logical geometer, expressing *his own* satisfaction with such evidence as his senses and his experiments afford him; but still we entreat him to pause before he dismisses this question so cavalierly from his mind. He will soon see that not only *intellectually* is his knowledge of an infinitely inferior class, but that in reference to *practice* itself, his knowledge is as inferior to that of the rational geometer as it is intellectually.

We ask him, whether his kind of knowledge would have enabled him, *in initio*, to have invented this method of construction? Let him look at the operations which he performs with due attention, and then say whether there be any one of them which, upon the face of the process, has the slightest apparent tendency towards the ultimate production of the regular pentagon? He will not venture to answer in the affirmative; or if he do, it will only be in mere random ignorance of what he says. There cannot be, in fact, the slightest probability entertained of such a result flowing from those operations; and we will add more —that could we suppose a practised rational geometer to have by some accident never studied that construction, and it were now propounded to him for the first time, even *he* would not perceive the tendency of that operation to produce a regular pentagon, *without first going through the demonstration with logical care.* It is very improbable, then, that the mere practical geometer should have *invented* that process; and indeed, we can hardly suppose that he will prefer his claim to the inventions in even practical geometry beyond the simplest and most obvious constructions. He must trust to the theoretical geometer for even his own practice.

The instance we have just given, so far from being a solitary one, is only a very limited specimen of the class of practical problems that the professional engineer and architect are called upon to construct. It is sufficient as an illustration of the fact—that had the theoretical geometry of the school of Plato not been created, there could only have existed an extremely small number of the practical geometrical constructions that are in daily professional use. This, at any rate, ought to produce a feeling very different from the supercilious contumely with which "practical men" are wont to treat the "mere theorist;" and should create a feeling of respect for the superior mental powers of the logical geometer, and gratitude for the benefits which he has conferred upon the arts of construction. But this is not all. The problems of plane geometry, important as they are, are far less important than those which have relation to space of three dimensions. It is true, that most practical men have obtained a few crude notions respecting orthographic projection, and can perform some trivial operations connected with "plan and elevation," whilst a select few "can put a building in perspective." Still their know-

ledge is of the same nature as their knowledge of the construction of the pentagon, whilst their conceptions are still more confused, and their operations more hesitatingly performed than they were in that case. A slight variation of the data of the problem, under certain circumstances, creates insuperable difficulties, and the artist is at length obliged to complete his work *trusting to the eye alone;* or else to construct the whole in model at great labour and expense,—and this not for *illustration* or the facilitation of clear conception, but for the purpose of obtaining a *scale of actual measures* for the construction of the work. The theoretical geometer, on the other hand, would have in general been able to have deduced all the measures, to have formed all the scales, and to have indicated all the constructions which would have been requisite for the object in view; and that at far less expense of time, in a manner perfectly applicable to all possible cases of magnitude and proportion, and accompanied by demonstrations of the inevitable correctness of the entire series of steps in the process. In fact, the theoretical geometer is the only really practical geometer; and those who commonly call themselves practical geometers are mere mechanists, working by rule, as much as the carpenter or bricklayer; only they work with different instruments and with greater delicacy of manipulation.

We have, in a former paper of the *Miscellanea Mathematica,* referred to the late Mr. Nicholson, as the only English writer on the geometry of space in reference to the arts of construction. Nicholson is admitted on all hands to have been acquainted with the ancient geometry, both as to principles and methods; and it would be difficult to show that he has left a successor who is wholly given up to the objects that he had in view—the application of pure geometry to the arts of construction. His works too, as we have said before, are the only ones to which the profession can refer with the slightest expectation of finding any process that may be required for practical use. This circumstance of itself would, we should think, have its weight with our "practical geometers" who have so insultingly contemned "theoretical persons;" inasmuch, as it shows them that the few rules of which Nicholson has put them in possession, were not the inventions of mere mechanical draughtsmen, but the reward of theoretical investigation.

We must be allowed a momentary digression. It is insinuated by Tredgold *(Joinery, Encyc. Britt.)* that Nicholson "derived much assistance" from the writings of Monge and others of the French geometers. Now, we yield to no one in our admiration of the French writers on these subjects, and we believe we are in a condition to offer a decided opinion on this question. It will be recollected that a considerable portion of the works of Monge—(all, or nearly all, that related to the point, line, and plane) —was translated by the late Mr. Webster, and published in *Nicholson's Architectural Dictionary.* This article embodied, in a most elegant form, the fundamental principles and elementary practice of descriptive geometry; and hence the system was laid open to professional men as much as it was to Nicholson himself, and the same "assistance" might have been derived by others that is alleged to have been derived by Nicholson. If, therefore, he has really so obtained the stated assistance, and others have not, it must be attributed to the superior power which his *theoretical* geometry gave him over his competitors. But we more than question the statement; we dispute its truth. Nicholson never fully comprehended the character of the descriptive geometry, and the few elementary constructions which he has given in his works, bear ample testimony to his never having been familiar with the French writers on these subjects. Beyond picking out an isolated construction here and there, and modifying it to suit the *un*geometrical minds of his "practical" readers, we know of nothing that Nicholson *can* have taken from that source; and we confess it appears like injustice to Nicholson to suppose that he was incapable of devising those constructions, as their difficulty is, in every case, by no means great to a mind familiar with the objects to which the constructions related. There is still to be urged in confirmation of Nicholson's having really invented those processes, that the development of them is, in general, inferior as to arrangement

of work and facility for obtaining the results, to those given by the French writers. Can any stronger proof of the independence of Nicholson's invention of them be offered? Still we would not, for one moment, suggest in explanation of Tredgold's error, that it was a mere ebullition of professional jealousy, or any thing more than a mistake, to which his own extremely confined knowledge of these subjects would render him peculiarly liable.

But supposing for the moment that Nicholson *did* copy from Monge, let us ask our "practical geometers" who and what Monge was? He was appointed at twenty years of age professor of geometrical drawing in the school of military engineers at Mezières; he being then undisputedly the finest draughtsman of his time even in France. But he was more than a mere draughtsman: there was not his superior either in genius or acquirements in Europe—though Euler, Laplace and Lagrange were his contemporaries. Monge's discoveries were scientific discoveries — his inventions were the reward of his real science. The "Descriptive Geometry" was only one small part of his contributions to mathematical discovery: though from being the most practical it has obtained for him a wider and more popular celebrity than all his other researches. Still, none but a man of the most profound geometrical science could have produced the system to which his name must ever be attached. Yet let us not be misunderstood. Many of the *processes* themselves which Monge has so beautifully systematised were matters of familiar knowledge amongst the French architects, long before Monge's time; and in most cases, *demonstrations*, more or less elegant, are to be found in earlier works—especially in the writings of Desargues and Frezier. Monge's great merit as regards this class of researches (we except, in the present case, the merely theoretical applications of his principles) consisted in his giving to the scattered elements of construction a consistent arrangement, dependent upon pure geometrical relationship. His work contains the real general problems that occur in construction — not their applications to specified professional cases. This latter object has, however, been amply fulfilled by his pupils and successors. The inventors of the problems which Monge found in existence, were also rational geometers; and without a considerable degree of such power as the rational geometer alone possesses, those constructions would never have been invented. Let us not, then, "lay the flattering unction to our souls" that at any period of practical history the processes of the geometry of space have been invented by mere experimental and empirical persons. Mentally speaking, "there were giants in *those* days," as well as in our own.

We have said that Nicholson was a geometer in a rational sense; yet his was limited knowledge, and his skill was not of a high order,—nor were his views or researches either widely expanded or geometrically elegant. In respect to the geometry of space, he had no English models upon which to form his mental habits; and he appears, indeed, to have viewed every problem which he undertook strictly and entirely in reference to the practical object that suggested it. His researches terminated with the solution of which he was in quest; and of any attempt at systematising his results with the results of collateral general inquiries, none of his writings display the slightest trace. He seldom gives a demonstration of any process—never but of the simplest; and we have good ground to doubt whether, as a general practice, he ever took the trouble to write out a demonstration of any considerable degree of complexity. Those which he has given are almost invariably clumsy and inelegant; and it is more than possible that his real investigations were mentally performed upon unlettered models of the objects under consideration. He, however, understood what the "profession" of his time required—*rules, not reasons;* and he was too wise a book-maker to increase the price of his works by the insertion of what he foreknew nobody would read.

Although Nicholson has thus added to the rules for actual construction a number of useful processes, he has at the same time, somewhat encouraged the system of experimental geometry amongst professional men which we so strongly deprecate. Yet we would urge that Nicholson owed his discoveries to the amount of geometrical science which he possessed, and not to mere tact,

shrewdness of observation, or still less to a mind of any peculiar powers. His powers were in no respect above the average of those of his contemporaries: but his mental discipline had been different from that of his professional brethren. His history offers no justification for the architect and engineer of our day affecting to despise, or even for neglecting, the study of the rational geometry in a systematic form.

The demands both of architecture and engineering upon geometry are, however, daily becoming more numerous and more profound in their character. Who is to answer these demands? Most assuredly not the mere mechanical draughtsman or experimental geometer. The ordinary courses of theoretical solid geometry contain but little research into the class of problems which these professions require. In themselves and apart from their uses, too, these problems possess but little interest to the speculative geometer; and he is not likely to enter upon such investigations without an adequate personal motive. The ordinary technical terms, also, in which those problems are expressed amongst workmen, render them unintelligible to the general scholar, and hence there is little prospect of obtaining the aid from him which we have obtained in the problems of plane geometry. We are therefore thrown upon our own resources, and it becomes imperative that we devote our own energies to meet the exigency. A better opening for the exertions of the fairest professional ambition cannot be pointed out, than that which is furnished by the cultivation of the *Descriptive Geometry* and its application to practical purposes. Yet, let no one dream of a "royal road to geometry," or imagine that this career is open to any but those who enter at the "wicket-gate" of Euclid himself.

If the reasons we have given shall effectually convince our professional students that a regular and systematic study of the pure geometry is *essential* to the accomplishment of his hopes and designs in life, we shall not have penned these remarks in vain. We cannot indeed bring ourselves to believe that our representations will pass wholly unheeded. We shall, therefore, proceed to show them *how* to pursue their studies, —to remove a few of the preliminary obstacles,—and to trace the subjects that will especially and successively demand the attention of the student.

## QUERIES RESPECTING THE OBLIQUE ARCH.

BY T. S. DAVIES, ESQ., F.R.S., LONDON AND EDINBURGH, F.S.A., ETC.

Sir,—You were so obliging a few weeks ago as to print a letter from me, in which I was "the burden of my own song"—a mere letter of self-defence against accusations made or implied, of my acting with *mala fides* in respect to Mr. Christie's MS., and with suspicious indecision with respect to those of Mr. Horner, on the subject of *equations*. I have every reason to believe that my explanation was satisfactory; but there is one remark I still wish to make—that since I have possessed Mr. Horner's papers, or saw that of Mr. Christie, I have never published a single line on that or any collateral subject which contains a shade of idea that was not previously in print. This statement I had made in a note at the end of the MS. of Mr. Horner's paper, which I had written out for the *Mathematician*, and which, therefore, as the printing of that paper had been promised by the Editor to take place so soon, I did not think it necessary to repeat in your Magazine. I only refer to it now because the promised completion has been again delayed. I now proceed to other matters.

The geometry and the statics of the oblique arch had engaged my attention at a very early period of their introduction into railway engineering: but circumstances so often diverted my thoughts into other channels, that it became impossible for me to collect the scattered rays of information respecting their progress and success, that I was desirous of doing. Duties, however, of a professional nature have recalled my attention to this subject, and I am desirous of obtaining all the information I can respecting particular points connected with those oblique bridges which have been already constructed, or which are in progress or contemplation.

It has been suggested to me that the

most probable mode of successfully making my object known to those gentlemen who are able to supply the information, is, that of requesting you to give publicity to my queries. The wide circulation of your work amongst architects, engineers, and others conversant with the subject, will, I am sure, afford me a *chance*, at least, of accomplishing my purpose. Nearly all my queries relate to actual practice and the more immediate reasons for it; or else to the results of that practice. With respect to the *theoretical mathematics* involved in these constructions, whether relating to the geometry or the statics of them, I have no special questions to ask, believing that on these heads no material information can be supplied that I do not already possess. At the same time even mathematical investigations are capable of improvement, and any such, should they occur to the readers of this letter, will also be respectfully received.

And now a word as to my special reason for this set of queries. It is an entirely mathematical object that I have in view, and the testing of the mathematical theory of these arches by a comparison with practical results. Whether my inquiries will terminate in such a way as to justify publication, it is impossible to foresee; but should they so terminate, those gentlemen who shall assist me will find, at the end, no reason to regret the trouble they shall have taken in complying with my request.

It will be obvious, that for authentication, each of my correspondents should entrust me confidentially with his name: but no use shall be made of that confidence where a wish is expressed not to have it published. This will also be necessary on account of any explanation I may require, whether arising from oversight in the writer, or from my misapprehension of his meaning. Not being myself a practical engineer, I am not altogether familiar with the technical terms in use amongst workmen, so that where these can be avoided it will add to my convenience to substitute others more generally known amongst men of science, or else to furnish me with brief definitions of them.

May I ask you to take the trouble of receiving for me any communications which are too bulky for postage? I inclose a private memorandum to say how you can forward them. As regards all communications by post, I will ask my correspondents to address to me direct.

1. The *dates* at which the bridge was commenced and completed? Also the names of the architect and builder?

2. The *material*—brick or stone?

3. The *angle of friction*, *co-efficient cohesion* and *specific gravity* of the material?

4. Whether the *cement* was trusted to for adding to the strength, and if so to what extent?

5. The *obliquity* and the *dimensions in plan*?

6. The *height* of the springers; the *right section* of the arch; and the *outline elevation* of its faces?

7. If of worked stone, then the mode of *dividing* the soffit course of voussoirs on the face: that is, all equal, or gradually diminishing in breadth from the obtuse to the acute spring, and if the latter, according to what law?

8. What method of *forming the templets* and *working the stones* was adopted, and did the stones require further dressing upon being placed?

9. Were the joints formed by *plane surfaces* or by *helicoids*?

10. Whether any direct and definite method of *calculating the pressures* of the different parts *and actual strength of the bridge* was adopted? and if so, on what principle?

11. Whether any *accident* occurred, either during the progress of the work or subsequently—as partial disruption or total destruction? In such case to what cause was this supposed to be attributable?

12. The *greatest load* that the bridge is considered capable of sustaining? and the greatest to which it can under ordinary circumstances be subjected?

13. Are there any declared opinions of experienced engineers on record, as to the *amount of the obliquity* upon which such a bridge may be constructed? and as to *any law* in the decrease of strength with increase of obliquity?

14. References to, or abstracts or copies of, any article, memoir, discussion, or newspaper paragraph, relating to this class of bridges, will be very acceptable.

Moreover, if any tracts have been published in the country, their titles and the name of the London publisher will be desirable.

15. Any other information which in the view of my correspondents may affect the stability or improve the operations occurring in actual construction.

I am, Sir,
Your obliged and obedient Servant,
T. S. DAVIES.

Royal Military Academy,
Woolwich, April 11, 1846.

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### APPROXIMATE DEVELOPMENT OF THE CIRCLE.

Sir, —The following construction, which I have enclosed in compliance with the request on the cover of the *Mechanics' Magazine*, was, together with the other method in your possession, and that given in the *Mathematician*, discovered about two years since; but I trust you will not imagine that my enquiries could have been directed to the *absolute* quadrature of the circle. In fact, that which I now send, and which was the first found, forced itself upon me, as it were, whilst looking over a table of square-roots; the figures in the decimal part of $\sqrt{145}$ striking me as being nearly the same as those of $\pi$.

This first construction led me to examine whether by combinations of such roots something more approximative, or more simple, might not be obtained, and the result was the two other constructions.

I remain, &c.,
HUGH GODFRAY.*

Jersey, March 16, 1846.

*First Construction.* (Fig. 1.)

Let ABC be the given circle. Through the centre, O, draw any line, AK, and make OD, DH, HK, each equal to the diameter. Bisect OB in F, and draw the perpendicular, KR, equal to OF. Join OR, cutting the circle in P, and on it set-off RM equal to HF. Next, make $M\omega$ = three times MP, and $P\alpha = \frac{1}{5}OP$,† then will $a\omega$ = circumference very nearly.

For let diameter be taken for unity :—

$$a\omega = aP + 4PM$$
$$= aP + 4(PR - HF)$$
$$= aP + 4(OR - OP - HF)$$
$$= \cdot 1 + 4(\sqrt{OK^2 + KR^2} - \tfrac{1}{2} - 1\tfrac{1}{4})$$
$$= \cdot 1 + 4\left(\frac{\sqrt{145} - 9}{4}\right)$$
$$= 3 \cdot 1415946.$$

Fig. 1.

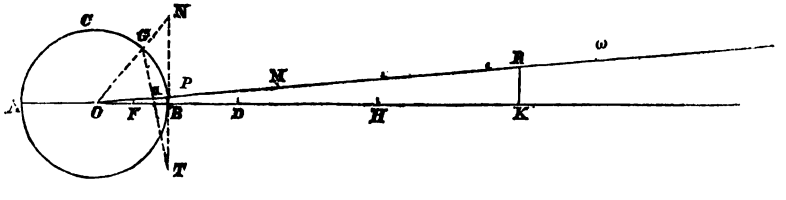
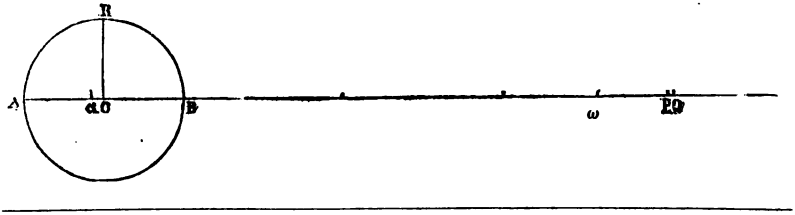



Fig. 2.

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* We have thought it right to give both the constructions forwarded to us.—ED. M. M.

† The best method of finding $a$ is a follows: draw any radius OG which produce till GN = OF; next join NP, and on NP produced make PT = NP; and lastly, join TG, cutting OP in $a$, $aP$ will be $\frac{1}{5}$ OP.—See *Davies's Hutton*, vol. i. p. 379., 4th Method. H. GODFRAY.

*Second Construction.* (Fig. 2.)

Draw the radius, OR, perpendicular to the diameter AB, upon which produced set-off BP=3AB.

Set off PR from O to Q, and finally make P$\alpha$ and A$\omega$ each equal to QR; then shall $\alpha\omega$ be the circumference nearly.

For let diameter be taken for unity,

$$\alpha\omega = P\alpha - P\omega = P\alpha - (AP - A\omega)$$

$$= 2QR - 4 = 2\sqrt{QO^2 + OR^2} - 4 = 2\sqrt{PR^2 + OR^2} - 4$$

$$= 2\sqrt{(OP^2 + 2OR^2} - 4$$

$$= 2\sqrt{(3\tfrac{1}{2})^2 + 2(\tfrac{1}{2})^2} - 4 = \sqrt{51} - 4$$

$$= 3{\cdot}1414284$$

[The more fitting place for this paper would have been in the *Miscellanea Mathematica;* but the space devoted to that subject being already occupied, we have thought it desirable rather to make it a separate article than to defer it till a future Number. We contemplate, however, occasionally resuming the subjects of our past articles in the *Miscellanea Mathematica*, when we shall either use, modify, or comment upon the various communications with which we are favoured by our correspondents. We trust they will take in good part the inevitable delay—a delay which they will now perceive to be beyond our control, without a material alteration of our plan. In fact, the interest created by these articles has gradually led us to expand our original design; and we trust we shall receive that assistance from our friends which will lighten our own somewhat considerable personal labours.—ED. M. M.]

## NEUTRAL SERIES—REPLY BY PROFESSOR YOUNG TO MR. COCKLE.

Sir,—I take the earliest opportunity to trouble you with a few remarks in reference to a suggestion to which my attention has been called by a very able analyst in a recent Number of your Magazine.

The statements marked (1) and (2), in which that suggestion is embodied, will, I think, be found to be in complete accordance with—and, indeed, to be implied in—the observations on *Neutral Series* in the November Number of the *Philosophical Magazine*. From the tenor of those observations it will be perceived that I do not regard the series

$$1-1+1-1+1-1+ \&c. \ldots . \quad (1)$$

as correctly representing what

$$1 - x + x^2 - x^3 + x^4 - x^5 + \&c.$$

becomes in the extreme case of $x=1$, whether this case terminate a continuous series of *ascending* or a continuous series of *descending* values of $x$; although, as I have noticed, it is the form in which this extreme case is usually written, and to which there would, perhaps, be but little objection, if the general principle of continuity, by which it is indissolubly united to the series of cases which it terminates, were always recognized by the mind, though not presented to the eye; that is, if it were always considered as identical with

$$1-(1-\tfrac{1}{\infty})+(1-\tfrac{1}{\infty})^2-(1-\tfrac{1}{\infty})^3+* \ldots .$$

when $x=1$ terminates ascending values of $x$, and with

$$1-(1+\tfrac{1}{\infty})+(1+\tfrac{1}{\infty})^2-(1+\tfrac{1}{\infty})^3+ \ldots \quad (2)$$

when $x=1$ terminates descending values. It is evident that these are the forms spontaneously furnished by the analysis. I do not *introduce* the symbol $\frac{1}{\infty}$. It is the unavoidable result of the hypothesis; and therefore I have no right to *suppress* it, unless, indeed, I can show that no error can possibly arise from such suppression. Now, $\frac{1}{\infty}$ being in reality zero, I could easily succeed in showing this, provided the zero never came into combination with infinity; but, in the matter before us, it *does* come into such combination, thus causing in the terms infinitely remote a total departure from the form of (1), as indeed Mr. Cockle has

* The strictly *neutral series* (1) is ambiguous in value; it is indifferently 1 or 0. The series (2) is the last or final one of a continuous group of *converging* cases—its value is one-half; and the series (3) is, in like manner, the last of a continuous group of *diverging* cases; its value is ambiguously $+\infty$ or $-\infty$. The prevailing error is, by suppressing all indication of the connection of these latter series with the groups to which they respectively belong, and thus confounding them with (1)—to treat them as neutral series, uninfluenced by any condition of continuity. This is uniformly done by Hutton, whose term, *neutral* series, it will be seen I use in a distinct and different sense. I laboured to impress the necessity of this distinction upon Mr. Moon, in the *Philosophical Magazine*, but it seems without success; as that gentleman continues under the delusion that the three series are identical, and equally ambiguous. It would be quite as correct to regard $\frac{0}{0}$ as always arbitrary or ambiguous, notwithstanding that we know the law which governed *all* the cases, the last of which assumed this form.

justly remarked—"Why should the *last* of a continuous series of results be set free from the influence of a law that confessedly binds the whole? If the last case may be thus set free, why not the last but one, the last but two, &c.; *where*, in short, does the law cease to operate?" Nothing is more common than this arbitrary exclusion of the terminal cases in the writings of analysts. The investigations of Cauchy, Poisson, Fourier, and others, abound with these exclusions; and, as I believe I have already shown, important errors have thus been stamped with the sanction of their great names, in other departments of analysis as well as in series.

Analysis, if left to itself—if I may use the expression—will always be found to be very refractory in such cases, and cannot be deprived of its own indications without violence. A good illustration of this may be adduced from the ordinary principles of analytical geometry, and as it will at the same time afford an opportunity of correcting a mistake which is, I believe, universally prevalent, I may perhaps be permitted to notice it in this place.

In all books on analytical geometry it is taught that $1 + a\,a' = 0$ is necessarily the criterion of perpendicularity of two straight lines whose co-efficients of inclination are respectively $a$ and $a'$, the axes of reference being rectangular. But this is not universally true; it is true only on the condition that $a \sim a'$ is *finite*. If this be infinite (as it is when the two lines are parallel to the axes) the preceding criterion is *not* necessary. And it is on this account that the equation of condition which connects together the inclinations of every pair of conjugate diameters in an ellipse, viz., the equation

$$\tan a' = -\frac{B^2}{A^2 \tan a}$$

I say that it is on this account that the equation here exhibited involves no violation of first principles in the extreme case of $a = 0$, where the conjugates coincide with the principal diameters; for we here see that the condition

$$1 + aa' = 0, \text{ or } 1 + \tan a \tan a' = 0$$

is *not* satisfied: the condition that *is* satisfied is $\tan a' - \tan a = \infty$; which is sufficient for perpendicularity.

Now if any one were asked to state the tangent of the angle which the minor diameter of an ellipse makes with the major, he would no doubt say $+\infty$; yet the analytical expression above makes it $-\infty$; how is this? The answer is obvious:—the right angle furnished by the preceding formula is that which terminates a continuous series of *obtuse* angles; and the analysis, by preserving the minus sign, (which we have no right to obliterate,) records this fact by indications of its own. If the right angle had terminated a series of acute angles, + would have appeared as the proper *sign of continuity*. The symbols $\frac{1}{\infty}$ and $0\sqrt{-1}$, I have already proposed to call *symbols of continuity*: we see also that the signs + and − may likewise perform a similar office.

I may remark, in conclusion, that it is possible that a person disposed to mere verbal criticism might object to the language employed above, as to the right angle being the last of a series of obtuse angles, or the last of a series of acute angles; maintaining that the *right* angle can never, in reality, be either the one or the other. But this objection may easily be removed by a little circumlocution: we may say, in the first case, that the right angle is the last of a continuous series of angles whose tangents are all *minus*; and in the second case, that it is the last of a series whose tangents are all *plus*. Viewing the right angle independently, in its isolated, individual character, it has evidently no more claim to a *plus* tangent than to a *minus* tangent: the tangent, as to sign, is ambiguous, as is plain from its definition. I remain, Sir,

J. R. YOUNG.

Belfast, April 6, 1846.

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**POWER AND TONNAGE — ROYAL STEAM NAVY *v.* ROYAL WEST INDIA MAIL COMPANY.**

Extract of a letter from an officer of H. M. Steam frigate *Samson*, dated Madeira, March 4th, 1846:—"The engines work so smoothly that there is not the least jerking with them, and they have done their duty well in this last gale—such a gale as I hope we shall never have to encounter again. The *Tweed*, one of the crack West India Mail Boats, sailed from Southampton on the 17th February, and the *Samson* sailed from Plymouth on the 20th following. The *Tweed* got to Madeira twenty hours before us, so that we beat her three days. The first five days she had fine weather, whilst we had scarcely any, and this should be reckoned relative to our comparative speed. Our name is up as being a fast vessel. We went twelve knots an hour under steam alone, coming into this port—when we got smooth water the engines making eighteen and a half revolutions. I never was in a vessel before where we had to ease her, going head to sea. We have been glad to give all we could on purpose to make them steer, but the *Samson* goes too fast, so that we have been forced to ease the engines. The *Tweed* could not stand the gale, but it well tested our sea qualities; and we all like the *Samson*, as being a perfect steamer, and a good sea-boat."

## THE NEW WOOLWICH COURSE*.

The "Woolwich Course" has long had the reputation of being the best body of practical mathematics of which this country could boast. Hutton, who composed it for the use of the Royal Military Academy, was generally allowed to be the most qualified man of his time for the task, and Gregory and Davies, by whom it has been successively enlarged and amended, have both been distinguished as able and successful teachers. Neither in our humble judgment has its high reputation been at all undeserved. Not only was the "Woolwich Course" on its first publication "greatly in advance as to the manner of treating the subjects contained in it of all works which had then appeared," as the editor of the last edition (12th) of it truly observes, but it has kept to this day steadily in advance of all competitors.

For many years Dr. Hutton himself revised the successive editions of the work, and carefully introduced into it every new improvement suggested by an ever-enlarging experience, aided by the progress of mathematical knowledge; and the same judicious course was pursued through another long series of years by his successor in the Woolwich chair and editorship of the "Woolwich Course," the late lamented Dr. Gregory. From Dr. Gregory the charge of the work passed into the hands of Mr. Davies, by whom the last and best of all the editions of it has been lately produced. When speaking of this edition on a recent occasion, we earnestly recommended it to all who might desire to pursue a regular course of elementary mathematical study, as being better fitted for such an object than any work of the same size and price with which we were acquainted; and to this opinion of it we most conscientiously adhere.

With these recollections of the "Woolwich Course" and abiding impressions of its merits on our minds, it gave us more surprise than we can well express, to learn that the work had latterly fallen into discredit with the authorities at Woolwich—been actually forbidden to be used by those for whose use it was specially designed—been literally kicked out of the doors of its paternal home—was, in a word, *the* "Woolwich Course" no longer.

Behold a veritable academic revolution! A work, the growth of ages, honoured, admired, revered, demolished in an hour.

The uninformed reader will naturally suppose that some *new work* must have made its appearance, of such transcendant and surpassing merit as to make adherence to the old text-book of the Academy impossible. Nothing of the sort. The old text-book—the good, good, old text-book was discarded—not for the sake of any better in existence, but because some one said *he could* and *would write a better*. The joint and approved production of a succession of most eminent men was cast aside, simply because an accident of seniority had raised an individual to the Woolwich chair who fancied himself superior to all who had gone before him—who had the modest assurance to represent to his masters of the Board of Ordnance that the universally esteemed work of his predecessors was good for nothing—and thereupon made an offer of his own services to write a New Course which should be just the thing! So clear did it seem to the Board (so we must perforce assume) that there could be nothing *sinister*, nothing *selfish* in all this,—that the new professor could not possibly have any *mercenary object* to serve, by thus destroying the character of the text-book which he found in use at his accession to the chair, and clearing the way for one of his own composition and *to be sold for his own profit*,—and so perfectly certain also that the New Course of the new professor must be vastly better than the old, albeit, this new professor had never in all his life given the least evidence of possessing any original talent—so clear and certain was

* An Elementary Course of Mathematics for the use of the Royal Military Academy, and for students in general, by S. Hunter Christie, M.A., of Trinity College, Cambridge; Secretary of the Royal Society, Vice President of the Royal Astronomical Society, Corresponding Member of the Academy of Sciences and Literature of Palermo, and of the Philomathic Society of Paris, &c., Professor of Mathematics in the Royal Military Academy. Vol. I., "Arithmetic and Algebra." Published by the authority of the Master-General and the Board of Ordnance. London: pp. 589, 8vo., 1845.

all this, that the Board did not hesitate to lend their sanction to the immediate degradation of the Hutton-Gregory-Davies Course, and to the establishment of a nondescript sort of interregnum, pending the preparation of a new one by Professor Christie.

Had the Board, then, nothing more than the word of Mr. Christie for all that he asserted and all that he promised? Did he help them to no reasons for withdrawing their confidence from the old Course? Oh yes! He did help them to reasons, and such reasons, that were there not evidence extant under the Professor's own hand of their having been made use of, no one could believe they would ever have been uttered by human lips. What does the reader think was the prime fault of the Hutton-Gregory-Davies Course? It was too practical!! Yes, positively too practical!!! It abounded in "working rules and formulæ which, however they might occasionally be applied to professional subjects"—on such rare occasions for example in military life as a battle or a siege—were not the sort of things to form the accomplished soldier. Work was for the working soldier, and not for such high born youths as Woolwich delighteth to qualify for generalships and generalissimoships. How to take a fort was at best but ditchwork—how to storm a battery a mere affair of bone and sinew. Far other teaching than any which mere "working rules and formulæ," (those horrid bores!) could furnish was wanted. The grand object to be carried out in the education of young men for the military service, was to lead them to pause, to think, to reason, to ponder well, or as the new professor periphrastically terms it, to cultivate "habits of thought and powers of combining circumstances, and of foreseeing consequences!"—to turn them out to field and camp, profound thinkers and capital calculators,—excellent at a stratagem, sublime in manœuvre, quick in taking advantage of circumstances as they arise, shrewd in foreseeing every possible consequence of every possible movement, always careful to look before they leap, always deeply impressed with the soundness of the axiom, that "discretion is the better part of valour," and wholly free from any silly disregard for the memorable adage that

> "He who fights, and runs away,
> May live to fight another day."

Yes, these were the essential but difficult lessons required to be taught the Woolwich youth—these the arts by which future Marlboroughs and Wellingtons were to be formed. And yet so utterly had they been overlooked in the Hutton-Gregory-Davies Course, that it was "in vain to look into it for anything *even resembling a train of reasoning*." Hear this, all ye who have any lingering respect or affection for the favourite of your academic days. Hear this, all ye who fancy (as many we know of do) that in that Course, as it existed at the date of this sweeping denunciation, there were to be found as numerous specimens of exa ctand felicitous reasoning, as were ever collected within the same number of pages. One can fancy the Members of the Board of Ordnance, being not a little startled at this flight of their new professor—inclined almost to cry out "too much." Sharing no doubt as they did till now in the general belief of the excellence of the "Woolwich Course" they could not but feel astounded to learn, for the first time, that it was so utterly worthless, full of "practical rules and formulæ," of no professional use, and destitute even of "anything resembling a train of reasoning!" But then again, when one reflects on the respect which people in authority, habitually entertain for other people in authority, one can fancy also, the hesitation of the Board changing rapidly to profound reverence for the prodigious array of titles, with which the new professor backed up his modest pretensions to the dignity of an oracle. For, was not the man who so denounced the Hutton-Gregory-Davies Course a "Master of Arts of Trinity College, Cambridge," the reputed fountain of all English mathematical knowledge? Was he not to boot "Secretary to the Royal Society," that concentration of all the scientific wisdom of the country—all at least which is worth regarding, namely, that, which is combined with rank and station? Was he not also "Vice President'

of that other rare constellation of science and learning—"The Royal Astronomical Society"? Did he not moreover subscribe himself "Corresponding Member of the far-famed Academy of Sciences and Literature of *Palermo*"?—that no less world-renowned body "The *Philomathic* Society of Paris"? and that other illustrious celebrity, which, though of no place, has learned associates everywhere, the immortal Academy of "Etcetera"? Who could withstand such a pedagogue of twenty tails as this? Who indeed? The Board of Ordnance at least could not; they swallowed implicitly all that Mr. Christie told them, sanctioned the disuse of the Hutton-Gregory-Davies Course, and directed the new professor to prepare forthwith "A new course of Mathematical instruction expressly for this Institution."

Very seriously speaking, the whole of this affair has been neither more nor less than a scandalous job.—Never was an academical revolution brought brought about by more ridiculous pretexts, or for more worthless ends.—Never a professor so shamelessly unjust to his predecessors, or a superintending Board so pusillanimously ancillary to the egotistical and sordid schemes of a subordinate. The "Woolwich Course," as Mr. Christie found it on his accession to the chair, was an admirable Course, and more than ever entitled to respect and confidence. The only real fault which it had in the eyes of the new professor was, that it stood in the way of his self-profit, and self-glorification. He was fired with the noble ambition of being bookseller as well as teacher to the young cadets; but, liking at the same time to play a safe game, he cunningly contrived to get the established class-book put out of the way before he brought his own into the field. Nothing like being able to compel people to buy your wares! If, when Mr. Christie assured the Board that he could write a much better Course, the Board had bid him *try*, and ordered him in the meanwhile to stick to the old one, they would have only acted as common sense and prudence dictated; but to take it at once for granted, that the new work would be all that its conceited and mercenary projector predicated of it, was something even worse than favouritism—it was a gross dereliction of duty. How could they be sure that they were not sanctioning the proscription of a much better Course than any they might ever see again? Or how shut their eyes to the risk they were running of identifying themselves with one which might prove to be incomparably inferior? And how, supposing the latter to turn out to be the case, could they hope to justify themselves to their country?

The first fruits of this job are now before us.—It is the first volume of a new "Elementary Course" of Mathematics by Professor Christie, comprising the branches of "Arithmetic and Algebra." The title page states it to be "*published by the authority of the Master-General and Board of Ordnance*," and to be designed not only "for the use of the Royal Military Academy," but "*for Students in General.*" The intimation given in the words which we have marked in *Italics* denotes a comprehensiveness of benevolence for which we were hardly prepared to give the Board of Ordnance credit. We do not by any means, however, quarrel with it; we note it only in passing, because of the additional reason which it furnishes for a patient enquiry into the value of the gift they have made, or have been the means of causing to be made, to the mathematical world.

First of all, however, in order that the reader may not suppose we have been joking in our account of the reasons by which Professor Christie urged on the Master-General the necessity for this new Course, we must quote a passage or two from his own preface.

"It having long since become evident that the Course of Mathemathics bearing Dr. Hutton's name was by no means adapted to the instruction which had for a considerable time been adopted in the Royal Military Academy, and its use having in consequence been for some years discontinued, *it was considered necessary that a new course of mathematical instruction should be drawn up expressly for this Institution, and at the urgent desire of the Master-General of the Ordnance I have undertaken the performance of this task.* It has al-

ways appeared to me that to restrict the study of mathematics as a branch of military education, to the acquisition of *working rules and formulæ, which might occasionally be applied to professional subjects, was to lose* the most valuable result to be derived from it, one great advantage to be looked for from this study being, *the habits of thought which it engenders and the powers which it gives of combining circumstances and foreseeing consequences*, habits nowhere of greater value than in the military profession. To judge by the course of mathematics so long in use in this Institution, in which we in vain look *for anything resembling a train of reasoning*, this advantage would appear formerly to have been wholly overlooked.

"In the elementary course of mathematics designed for the instruction in the Royal Military Academy, of which the parts now published containing arithmetic and algebra form the first volume, I endeavour to supply this defect. To habituate the pupil to the exercise of his mind I have placed before him *the reason for every operation he is called upon to perform;* and as such habits, if not early acquired, become afterwards difficult of attainment, I have done this even in those operations which constitute the very rudiments of arithmetic. It may be thought I have dwelt too much upon these early principles, but long experience satisfies me that I am right in the view I have taken."

The reader will perceive from this that Professor Christie does (if he may be believed) entertain very seriously the notion that this New Course was imperatively called for by the gross defects of the Old, and that to him was reserved the arduous task of first teaching the Woolwich youth and "students in general" how to think and how to reason. With what success he has accomplished his task we shall now proceed to enquire.

Setting out as the author does with the professed determination of giving the reason for everything, it might have been expected that he would have begun, by explaining, first of all, to the pupil the signification of the name given to the branch of learning which he is about to study, its etymological origin and its conventional signification. Now this our new professor omits altogether, and contents himself with stating that "*under the term* MATHEMATICS are comprehended those sciences which treat of magnitude, number, and quantity." So that a book which is to explain everything begins with leaving unexplained the most important word in it!

Of the first of these properties, *magnitude*, we have the following definition:—

"By *magnitude* we understand whatever admits of increase or diminution; as *space* is magnitude, whether considered with reference to its length, breadth, or thickness, *which are lines;* with reference to two of these *which constitute surface;* or with reference to the three *which constitute volume*, —number, weight, time, motion, are in mathematics considered as magnitudes."

The office of a "definition" as the professor afterwards tells us, "is to explain one term by means of others in common use, or whose meanings have been previously explained." But here we have *magnitude*, which is a term so simple and common as hardly to require definition, explained,—by *space, lines, surface, volume, motion*, not one of which is a term "either in common use," (in the sense in which the Professor employs it,) or "whose meanings have been previously explained." "Space is magnitude," but what is space? The pupil is told that space may have length, breadth and thickness, but so also may a birch rod or a Cambridge sausage. Besides, is he not informed further on, that length and breadth are but "lines," and does not all the world know, (boys included,) that "lines" are mere mathematical nothings? So that according to this new method of making plain things plainer, magnitude may be space, and space may be—nothing! Again, the pupil is told that "two of these constitute surface." Which two? The pupil was to have the reason for everything given to him. Why then is he here put to guess what his teacher means? Is it so palpable a thing that length and breadth constitute surface without thickness,

that no "boy of fourteen years of age" (the professor's standard, see preface p. xii.) can miss seeing it instantly?

A little further on we have this definition of analysis.

"*Analysis*, or the analytic method, is, that by which a remote truth is discovered by assuming that what is required *to be done*, is DONE; and then by reasoning from the more complex back to the more simple, finally arriving at a known truth."

A fine specimen this of "a train of reasoning" according to the "New Woolwich Course." Not the like of it, we will answer for it, to be met with in all the Hutton-Gregory-Davies Course. A remote *truth* is to be *discovered* which is already "*a known truth*"! Something is *required to be done* which, it is assumed, is (already) DONE!

In the same lucid and not at all wordy or perplexing style the pupil is informed that—

"A *number* is said to be multiplied by the *number* which denotes the *number* of times that the first *number* is to be taken."

And that—

"A part of a *number* is a *number* which being taken a certain *number* of times the product is the given *number*."

The Professor gets plainer as he proceeds —improving no doubt by practice. That the whole is greater than any portion of it is notoriously a very difficult thing to prove, but the Professor furnishes the sufficient reason for it, in a single line:—

"The whole is equal to all its portions taken together"!!

Another thing which it has puzzled a good many to demonstrate is this—that if two numbers have to be added together, say 5 and 7, it is of no consequence which you put first, the 5 or the 7, the 7 or the 5. No former mathematician has, to the best of our recollection, ever favoured the world with a demonstration of this curious fact. Its extreme difficulty has, no doubt, deterred all alike from making the attempt. But see how cleverly the author of our "new Course" disposes of it—how successfully he brings his great reasoning powers to the aid of the poor bewildered learner!

"We may, however, here point out the REASON of this.

"7 is 5 with 2 added, or $7=5+2$; and, therefore, 7 with 5 added, or $7+5$, is 5 with 2 added, and 5 added,

or, $7+5=5+2+5$.

But 2 added and 5 added is 7 added,

or, $7+5=5+7$;

or thus,

7 is 2 increased by 5, or $7=2+5$;

and therefore 5 increased by 7 is 5 increased by 2 increased by 5;

or, $5+7=5+2+5$.

"But 5 increased by 2 is 7, or $5+2=7$; therefore 5 increased by 7, is 7 increased by 5; or, $5+7=7+5$.

"Or thus: on the principle that the sum of two numbers is the number of units in the one successively increased by the number of units in the other, which is in fact the only basis of all addition, in adding a greater number to a less, if the less be increased successively by an unit, until it becomes equal to the greater, there will still be the number of units in the less to be added. This, expressed by signs will be,

$$5+7=(5+2)+5=7+5."$$

Can the art of reasoning be carried further? Can anything more be wanted to show the value of the New Woolwich System as compared with the old? If we might humbly suggest something in the way of extension,—if not of improvement,—it would be that the author should in future editions, (of which, as long as he retains the fortunate power of compelling every cadet to buy a copy, there will be plenty, no doubt,) add a few "Examples for Practice," by way of fixing more permanently in the mind of the pupil the singular property of numbers which he has in this instance so beautifully developed. *Ex. gr.*—

"Example for Practice.

"A certain schoolboy, having had on a holiday two shillings given him to spend, he sat him down on a stone by the wayside, to think which of the two he should

spend first. An old woman happening to pass by, and seeing the youth in trouble, asked the cause; on learning which, she showed unto him how it was all one which he did spend first. Explain what was the Old Woman's Method."

The reader will be pleased not to suppose from this friendly suggestion of ours, that a want of "Examples for Practice" is at all a prominent feature in the New Woolwich Course. On the contrary, it abounds to excess in this sort of illustration, and if we mistake not, the learned author rather prides himself on the originality and fertility of invention which he has brought to bear upon it. "The large collection of examples appended to each subject, *nearly the whole of which are new*, cannot fail, if carefully worked out, to impress the principles strongly on the mind of the pupil." Mr. Christie's predecessors appear to have thought it might be as well, while endeavouring to make their pupils ready calculators, not to forget that they had moral characters at the same time to be formed, and they were therefore careful not to draw their examples for practice from sources which were in any way associated with habits of dissipation and vice. The new professor has viewed the matter more as a man of the every-day world, and drawn his examples from all sources, without restriction or scruple. Feeling impressed more particularly with the very notorious fact that a large portion of the leisure of guard-rooms and mess-rooms is occupied with wagering, card-playing and the like, and anxious to make his book of as much "professional use" as possible, Mr. Christie has thought it judicious to make all these things familiar beforehand to the mind of the military cadet. And hence such "Examples for Practice" as the following:—

"A and B began play with equal sums of money. A first won two sovereigns, but afterwards lost $\frac{1}{7}$ of what he then had; when appeared that A had only $\frac{4}{5}$ of what B what sum did each begin with?"—1.

"A and B severally cut packs of cards so as to cut off less than they left; now what A left added to what B cut off, made 50; and the cards left by both exceed those cut off by 64. How many did each cut off?"—P. 246.

"Two men who had between them thirty-five guineas, played together until one of them had won four guineas of the other; the winner had then twice as many guineas as the loser had at first. How many had each?"—*Ib.*

But to return to the master feature of the New Woolwich System, namely, the sufficient reason which it gives for everything—we observe that notwithstanding the remarkable instances we have cited of Mr. Christie's success in this line, he does ere long encounter some difficulties which he finds it rather hard to get over, and in fact shirks altogether. In treating of "common multiples" and "common measures," he mentions some properties of numbers which have an important bearing on this branch of arithmetic, but adds the following foot note:—

"These properties must for the present *be assumed, as they cannot be conveniently proved* without the aid of algebra," p. 39.

Again, to the "Tables of Measures" this note is subjoined:—

"In some of these tables fractional divisions occur, but as these are of the simplest kind they will present no difficulty to the student *although he cannot here be supposed to be acquainted with the arithmetic of fractions.* We have, however, been obliged to go a step farther than this in some of our comparisons by introducing fractions and also decimals. These parts can only be *properly understood* when the student has made himself master of the notation and operations to which they refer, and must therefore, until he shall have done so, be PASSED OVER. For the present his business is with the tables themselves, in order to enable him to apply the four fundamental operations of arithmetic to concrete numbers," p. 39.

The remarkable discrepancy between these passages and the boastful pretensions with

which our new Professor commenced his task is as amusing as it is instructive. In his preface, written of course like other prefaces *after* the book was written, and when he knew well all that it contained, and all that he had been able to effect—he says, "I *have* placed before him (the student) the reason for *every operation he is* called upon to perform, and I *have* done this even in these operations which constitute the very rudiments of arithmetic." And yet we have it under his own hand that before he had got through forty pages of his work—while he was yet in the very midst of the rudiments of arithmetic, he was under the necessity of asking the student to *assume* many things that he could not "conveniently *prove*" to him on the instant, "and which could only be *properly understood*" by him at some *future* stage of his progress. That is to say, Mr. S. Hunter Christie gives the lie direct to Mr. S. Hunter Christie! Oh! rude Mr. Christie! Would it not have been better to confess honestly your utter failure? What though you might have damaged thereby your pretensions as a man of science, you would have saved your character as a man of truth and sincerity. What though you had owned to a miserable failure in performance—you might have fairly pleaded in mitigation of censure that you had but failed where probably no one else could have succeeded. We own ourselves to be among those (a majority we believe of all who are conversant with the teaching of mathematics) who think that to attempt to make plain to the understanding of a pupil "the reason for every operation he has to perform" in the earlier or rudimental stages of his progress, must either be a superfluous or a hopeless task. The reasons are usually either so palpable as to need no demonstration, (as witness the examples of foolish babble which we have quoted from Professor Christie,) or so recondite as to be beyond the comprehension of persons first commencing their mathematical studies. The student who would not tarry needlessly by the way, must in the first instance take much of all he is taught purely on trust. If he insist at every step on having the sufficient reason for that step he will never get even a distant sight of the *pons asinorum*. It is only through practice, and much of it, that people can (in this instance at least) arrive at principles. We count it therefore no reproach to Mr. Christie that he should have failed to perform the impossible sort of task he assigned to himself; but we do look upon it as matter of very grave reproach, that he should first prevail upon the Ordnance-Board to cashier the old "Woolwich Course," because of its not giving "the reason for every operation," and then obtain their sanction to the New Course, ("published by authority") as being wholly free from this alleged defect, whereas it differs from the old one, *quoad hoc*, no further than in either giving reasons which are ridiculous, or giving none at all; and above all, that he should confess in the body of his book (*where the confession had every chance of being overlooked by the Board*) that he has broken hopelessly down in his attempt to supply the alleged defect in the old Course, and yet audaciously pretend in his preface (*which the Board were sure to read*) that his success had been such as to leave nothing to desire! This is more than error, it is gross imposture.

We have hitherto looked at this New Course in those lights only in which the author has desired we should look at it—challenging for it, as it were, our scrutiny and admiration. But there are others which though kept more in the shade are not less obnoxious to animadversion. After boasting how much he has done in the reasoning way—with what truth we have just seen—Mr. Christie observes,

"Independently of these considerations the manner in which both arithmetic and algebra are treated in this volume, will be found *to differ in many essential particulars* from any similar treatises on the same subjects."—Pref. viii.

Differ it does, in many particulars, but oftener for the mere sake of differing, than for any useful or rational purpose. Let one example, selected from many which we have noted, suffice. In treating of algebra, the author, *before* defining what algebra is, or

explaining the signs, symbols, terms, and expressions used in it—*before* making the pupil acquainted with the "*fundamental* operations" of addition, subtraction, &c., plunges all at once into the very depths of the subject—treats at large of equation, transposition, and elimination! Anything more absurd than this we never met with in any elementary work before.

It happens sometimes too, that where Mr. Christie fancies he differs most from others, he most agrees with them. He gives, page 71, a rule, to "transform fractions with different denominators, into equivalent fractions, having a common denominator," and in a note subjoined, he thus specially claims the authorship of it.

"A rule equivalent to this, but in an inconvenient form, appeared in Bonnycastle's Arithmetic, published in 1820, but long previously I had given it as above in MS. in the Royal Military Academy, and had always insisted on its advantages. It has been given nearly in this form in a note in the later editions of Hutton's Course—(11th edition, 1836,) S. H. C."

The rule which Mr. Christie here supposes himself to have invented is to be found in almost every work on arithmetic written before 1800, and in many (besides Bonnycastle) which have since appeared. What are we to think of the pretensions of a person as a reformer of academical "Courses" who could be guilty of such gross ignorance as this?

In his anxiety to point out those respects in which his Treatise differs, or is supposed to differ from others, it seems to have altogether escaped Mr. Christie, that he was equally called upon by a sense of propriety to point out those in which it *agrees* with others—wherever at least the *agreeing* might, unexplained, resolve itself into so naughty a thing as *pilfering*. We must take leave to supply a few of the more remarkable of Mr. Christie's omissions in this respect. The method of finding "the greatest common measure of two numbers," p. 35, is taken from Mr. Davies's "Solutions of the principal questions of Hutton's Course." "Division" in algebra is made up almost entirely from the last edition (by Davies) of the much-calumniated old "Woolwich Course," and so also is the "Properties of Equations of all degrees," which includes an exposition of De Gua's criterion for the existence of imaginary roots, too clever by far to have been accomplished by any analytical skill possessed by Mr. Christie himself. The author's general rule, in short, is to appropriate all he can, and make acknowledgments to no one; nor will the reader's disgust at his systematic injustice to others be probably lessened by the fact, that the only person spoken of with unaffected praise throughout the volume, besides himself, is "*My son and colleague*, Mr. James R. Christie." In one instance, it is a leaf from Descartes; in another, a leaf from Vincent, for which the youth is extolled above all the mathematicians of his time. Not content with strutting himself in borrowed plumes, the old gentleman must needs stick a rare feather or two in young jackdaw's tail.

Perhaps, however, the most revolting instance of all, of Mr. Christie's disregard to the claims and feelings of others, is one which has been already the subject of considerable remark in our pages, and to which therefore we need do here little more than briefly advert. We allude to the charge in which the names of the late Mr. Horner and Mr. Davies are so strangely mixed up with respect to the method of continuous approximation; the one as filching from Budan, and the other from Christie, and both as having fallen immeasurably behind "my son and me," in developing the beauties of that method. After the solemn disclaimer by Mr. Davies himself, published in our Magazine, No. 1173, and the subsequent masterly examination in No. 1177, by Professor de Morgan of the claims of Budan, Horner, and others, in regard to the method referred to, we are certain that there can be but one opinion in the mathematical world as to the real place which Mr. Christie has earned for himself by his invidious labours.*

* See also a letter from Mr. Davies in our present Number, p. 284.

From all that has been stated, it is plain that a great act of reparation is demanded at the hands of the Board of Ordnance. The efficiency of one of the most important public institutions in the country has been seriously jeopardised "by authority;" the memory of former distinguished heads of the Academy, and the founders of its fame, has been insulted, and their labours traduced "by authority;" the character of the most eminent, by far, of the living masters has been slandered, and his usefulness impaired "by authority;" the dignity of "professor" has been merged in that of bookseller "by authority;" and a new course of instruction has been thrust on the Academy "by authority," which is deservedly the laughing-stock of all connected with the Academy, with but one old, and one young, exception. The Board was not entrusted with "authority" to commit such pranks as these, and if it would avert public indignation, it must undo all it has done as speedily as possible. The Hutton-Gregory-Davies Course must be restored to its former place as the text-book of the Academy; and if the present chief will not *condescend* (God save the mark!) to teach it, he should be made to give way to others who will. The spiteful abortion by which it has been for awhile supplanted, should be got rid of; and lest it should be said that the Board had, by their acquiescence, concurrence, or connivance, or whatever else it may be called, encouraged Mr. Christie to incur an expenditure for paper and printing which he would never otherwise have done, we would have any remnant of the work which may be in store, taken off his hands at something sufficiently above trunkmaker's price to be deemed not simply remunerative, but generous and liberal. Cost, in a case of this kind, ought ot to be considered. Be the cost what it ay, the *gravity* of the school must be stored. With the return of respect and nfidence, there would be a return of rmer times, when the Woolwich Academy id Woolwich Course stood second to none the kingdom, and to but few in any art of the world.

PROBLEM IN ORTHOGRAPHIC PROJECTION.

Sir,—It seems almost a matter of course, in the present state of education, that there shall be two distinct sets of minds—those which we are accustomed to call the *theoretical* and the *practical*. This renders it often necessary for the one class to consult the other upon subjects which, to the consulted, may appear very trivial. Perhaps the question I am about to ask may appear so to *you*; but, if it do not, will you have the goodness, when you have space and leisure, to give an answer to the following question? The subject has, I have reason to believe, occupied the attention of men of respectable mathematical attainments—nay, of considerable analytical ability. The *desideratum* is not, however, a solution by the co-ordinate methods, but a geometrical construction.

"Given two triangles, one in magnitude and position, and the other in species; to find a plane upon which, if the first be orthographically projected, the projection shall be similar to the second."

I am, Sir, &c.,

JAMES COCKLE.

Devereux-court, April 10, 1846.

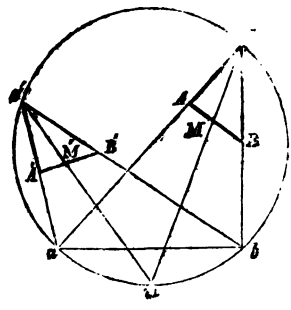
*Note.*

We beg of our very able correspondent to believe that, though somewhat practised in this class of enquiries, we consider his problem to be very remote from a trivial one. It is, in fact, one of the most difficult of all the practical problems in orthographic projection. It has never, we believe, received an English solution; and, as far as we are aware, there has been but *one* really complete and valid construction ever published. That one was given by M. Vecten, *professeur de mathématiques spéciales au lycée de Nismes*, and was published in *tome* ii. of *Gergonne's Annales des Mathématiques*, p. 307. Another attempt to construct it was made in the same work by M. Lhuillier of Geneva; but this was most incomplete and unsatisfactory. It was, however, transferred to *Leybourn's Mathematical Repository*, vol. v., p. 17: but on what principle that particular construction was selected for translation, we are unable to comprehend, except, indeed, the relatively smaller space required for printing it. The following are only

slight variations of Vecten's analysis and construction.

LEMMA I.

Fig. 1.



*If similar triangles* ACB, A′C′B′, *have their homologous angles* C, C′, *inscribed in the same segment* aC′Cb, *and if in each of them we draw* CM C′M′ *to bisect the bases* AB, A′B′ *in* M, M′: *then these lines being produced to meet the other segment of the circle, they will all meet it in the same point* m.

Dem.—Since ACB, A′C′B′ are similar triangles, and since AB = 2AM and A′B′ = 2A′M′, we have

CA : C′A′ :: AB : A′B′ :: AM : A′M′

and the angles CAM, C′A′M′ equal. Whereas the triangles CAM, C′A′M, are similar, and the angles ACM, A′C′M′ equal to one another. Wherefore they stand upon the same arc *am*; or CM, C′M′ pass through the same point, *m*.

*Cor.*—It follows from this that the triangle ACB being only given in species, and unknown as to magnitude and situation with respect to the chord *ab*, it is nevertheless possible to determine the point *m* when the arc *amb* is intersected by the line CM drawn from the summit C to the middle M of its base. It is, in fact, sufficient for this purpose to determine the point M for another triangle, A′C′B′, similar to this constructed arbitrarily, so as to have its angle C′ homologous to C.

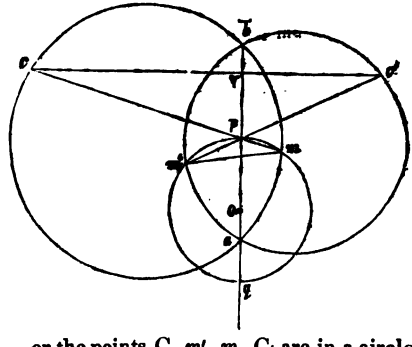
LEMMA II.

*Let there be two circles, having ab for their common chord, and a third circle having its centre O upon ab, cutting the two former in m and m′, and the chord ab in p and q; draw the lines mp, m′p to meet the two circumferences in C and C′; and finally draw CC′ intersecting ab in* γ : *then CC′ will be perpendicular to ab.*

Dem.—By *Euc.* iii. 35, we have

$p\mathrm{C}.\ pm = pa.\ pb = p\mathrm{C}'.\ pm'$;

Fig. 2.



or the points C, *m′*, *m*, C′ are in a circle, and the triangles C′*p*C, *m′pm* are similar.

Again, draw the line *mq* (which is accidentally omitted in the cut, and which the reader is requested to supply,) and we have in the triangles $p\mathrm{C}\gamma$, *pmq*,

$p\mathrm{C}\gamma = pm'm = pqm$, and $\mathrm{C}p\gamma = mpq$,

whence we also have $p\gamma\mathrm{C} = pmq$.

But *pmq* is a right angle, it being in the semicircle *pmq*; and hence also $p\gamma\mathrm{C}$ is a right angle. That is, CC′ is perpendicular to *ab*.

*Cor.*—We may hence resolve the following problem :—

*Two points, m and m′, being given upon two circumferences having the common chord ab, it is required to determine upon this chord, a point (which let us call p) such, that if we draw the chords mp, m′p to meet the circles in C and C′, the line CC′ shall be perpendicular to ab.*

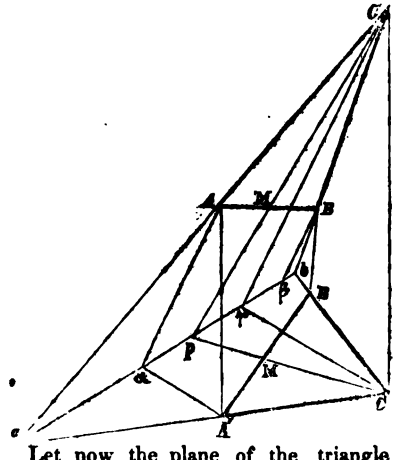
It is only necessary to describe the circle the centre of which is upon *ab*, and which shall pass through *m* and *m′*. This circle will cut *ab* in the points *p* and *q*, either of which will give the point required.

THE PROBLEM.

*Analysis.*—Suppose the problem already performed with the planes in their actual positions, and that ABC is the triangle to be projected; that A′B′C′ is its projection, similar to the triangle given in species; and that *ab* is the intersection of the two planes. Let M and M′ be the middles of AB and A′B′. Then M′ is the projection of M; and by familiar properties of the orthographic projection, CA, CM, CB being produced to the point *a*, *p*, *b* of *ab*, they will in those points meet the prolongations of C′A′, C′M′, C′B′ also, since AA′, BB′, CC′

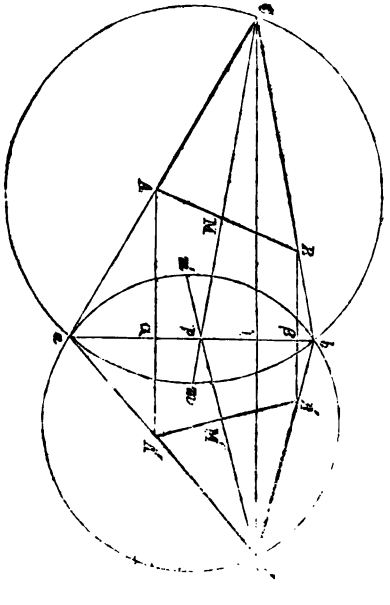
are perpendicular to the plane of the triangle A′B′C′, the lines $Aa$, $B\beta$ $C\gamma$ drawn perpendicular to $ab$, will meet $ab$ in the same points as the perpendiculars drawn from A′, B′, C′ to the same line $ab$.

Fig. 3.




Let now the plane of the triangle ABC be revolved about $ab$ into coincidence with the plane of A′B′C′, as in the figure annexed.

Fig. 4.



In the course of this motion, the points $a$, $p$, $b$, $\alpha$, $\beta$, $\gamma$, remain stationary; and as the lines $Aa$, $B\beta$, $C\gamma$ are in all positions of the revolving plane perpendicular to $ab$, they ultimately fall into the prolongations of $A'a$, $B'\beta$, $C'\gamma$. With respect to the length of the line $ab$, or any plane parallel to that of A′B′C, may be taken for that of projection, it follows that its length is perfectly arbitrary. Whence we are naturally led to the following

Construction. Upon the arbitrary line $ab$ describe segments of circles to contain the angle C and its correspondent projection C, these being on different sides of $ab$. Upon the other parts of the two circumferences find (*Lem.* i. *Cor.*) the points $m$ and $m'$ where the lines drawn from the summits C and C′ to bisect the bases, intersect those remaining segments. Upon $ab$ (*Lem.* ii. *Cor.*) find a point $p$, through which and the points $m$, $m'$ draw the chords $m$ C, $m'$C′, such that the straight line CC′ shall cut $ab$ perpendicularly in $\gamma$. Then C, C′ will be the summits sought.

Form, now, upon the sides of the angle C the triangle ABC equal to that which is to be projected; and draw AA′, BB′ perpendicular to $ab$ meeting $\alpha$A′, $\beta$B′ in A′, B′. Then A′B′C′ will be the required projection.

It is almost unnecessary to add that the inclination of the planes, is the angle comprised between $\gamma$C and $\gamma$C′, when they are made the hypothenuse and base of a right angled triangle.

*Scholium.*—Since the problem for the determination of $p$, has two solutions, viz., $p$ and $q$ we may be led to suppose that the general problem has two solutions: but a little attention to the details of the operation for $q$ will show that this case is inapplicable, and that the problem admits in reality of only a single construction upon the line $ab$.

Again, by a well known property of projected angles the projection is greater than the angle projected (except the planes are parallel, in which case the other angles are equal each to each, and both triangles of like species), and hence this condition should be carefully attended to in the solution of the corresponding angles C, C′.

Other remarks will occur to the intelligent reader which it is unnecessary to give at length here.

Ed. M. M.

We have already a good many works on the law of patents,—some very good, as those of Godson and Webster, and others very wretched, by authors whose names we shall leave unmentioned, since we cannot mention them with praise; but there can be no better proof that the best of them have left much to be desired, than the fact that we have now before us a much better than any of them. In comprehensiveness and completeness, the present treatise of Mr. Hindmarch much excels them all. It contains a large amount of valuable information, which is to be met with nowhere else, and throws light on not a few points, which greatly required clearing up. The principles of the law are everywhere expounded with admirable distinctness and clearness, yet with a most masterly brevity; and the references to cases and authorities copious and correct. The details of practice, too, are given with a circumstantiality and exactness, which literally leave nothing untold. Mr. Hindmarch mentions that in the parts of his work which relate to practice, "he has been favoured with the assistance of the officers by whom the various proceedings are conducted and prepared," and that he has "not stated anything on the subject of practice that has not been approved of by these authorities." Indeed it is hardly to be supposed that he could, without such special assistance, have produced a work so perfect in its practical chapters as he has done.

The notion,—a favourite one with inventors,—that every man has an inherent or natural right of property in what he is the first to devise or discover, is very properly discarded by Mr. Hindmarch as untenable, and the practice of granting to inventors an exclusive right to the use and exercise of their inventions for a limited period, is shown to have no other foundation than public utility.

"It has often been asserted that, according to the principles of universal equity, an inventor has an exclusive property in his invention. But it is clear that independent of positive law he has no such exclusive proverty any longer than he keeps it secret; for no one who first makes any discovery can thereby acquire the right to prevent others from *making* and using the same discovery. He may, if he please, conceal his discovery from the world, but the moment he publishes it, he abandons his *exclusive* property in it, and others acquire a right to use the invention in any manner they please. The exclusive right to use an invention after it is published, can only have existence, therefore, by virtue of some positive law, which is made with the actual or implied consent of the whole community.

"Every member of the community receives many benefits from the society in which he lives, and he is therefore bound by every means in his power, to advance its interests. And it seems but reasonable that he should be expected to promote the public weal by putting the community in possession of any discovery he makes, which may be for the public good. But invention is generally the result of much study and labour, accompanied with a considerable expenditure of time and money, and few persons have the requisite ability and inclination, without the hope of reward, to search for improvements in the arts, for the benefit of the public.

"The whole community is benefited by the promotion of the useful arts, and, therefore, it is for the public good to hold out the promise of rewards to the inventors of new and useful arts and manufactures, who may first put the public in possession of them.

"In some cases, where meritorious inventors could not be otherwise adequately rewarded, sums of money have been granted to them out of the public purse; but such a mode of recompense, it is clear, could not be generally adopted.

"The mode of rewarding inventors, which has been adopted in this country, seems to be the best that could be devised; it is, by granting the inventor a monopoly in his invention for a limited time. It is true that by such a grant every other person is restrained during the continuance of the monopoly from using the patent invention, even if he makes a similar discovery himself. But at the time the grant is made, it is by no means certain that the invention will be given to the public, or even made by any other person, and, by the temporary suspension of their right, the people acquire the certainty of being able to use the invention at the expiration of the monopoly. The reward which an inventor thus obtains, will, in general, be in proportion to the benefit which he confers upon the public for the greater the utility of the invention,

the more profitable will it be to the grantee of the monopoly.

"Speaking of such a grant, Sir Edward Coke says,—'The reason wherefore such a privilege is good in law, is, because the inventor bringeth to and for the commonwealth a new manufacture, by his invention, costs, and charges, and, therefore, it is reason that he should have a privilege for his reward, (and the encouragement of others in the like,) for a convenient time.'

"Utility to the public is, in fact, the consideration for every grant of the sole use of an invention, and letters patent, containing such grants, always state the public good to be the motive of the Crown in making the grants.

* * * *

"The total absence of utility to the public in any invention will at all times, therefore, vitiate a grant of the sole use of it; but it will not be void on that ground, if the invention was of any utility to the public, although such utility may be very small.

"But an invention may happen to be of some use to the public, and yet it may be so trifling or frivolous, that the inconvenience to the public arising from the grant of the sole use of it, would not be adequately compensated by the benefit which the public would receive from it. The law has deemed it right, therefore, that mere discovery of any new manufacture shall not vest the sole right to use it in the inventor: but that, in order to become entitled to such a sole privilege, he must obtain a grant of it from the crown, in whom the law has vested the power (which it exercises through its ministers) of judging not only whether the invention is likely to be of so much utility to the public as to render the making of the grant *a matter of public expediency*, but also what duration of privilege (not exceeding fourteen years) the invention merits.

"Accordingly inventors are *never entitled as of right* to letters patent, granting them the sole use of their invention, but they must obtain them from the Crown by petition, and *as a matter of grace and favour*, and letters patent always express that the grant is so made."

The period of fourteen years has been complained of as being in all cases too short, and the crown has been empowered by a recent statute to grant an additional term of years not exceeding another fourteen, whenever it can be shown to the satisfaction of the privy council that a patentee has not been sufficiently rewarded by his first term of monopoly. But there are those who contend that even twenty-eight years is less than inventors have a good right to, and that they ought to be placed precisely on the same footing as the authors of books, who have now a forty-two years' copyright in their productions. We must confess that we see no reason for the distinction which the law makes between inventors and authors in this respect; and we dare say, quite as plausible a case could be made out for an extension to 42 years of the monopoly enjoyed by the former, as that which carried the legislature captive in the case of the latter. But whether the term of a patent should be fourteen, or twenty-eight, or forty-two years, is a question of public policy alone, with which *right* has nothing to do. If it could be shown, that the rewards reaped by inventors under the existing short terms of monopoly, were not sufficient to rouse into full activity the inventive genius of the country, that would be a good reason for making them longer; but none other that can be suggested is entitled to the slightest regard. The legislature would be greatly to blame if it granted a monopoly, of this or any other description, for a day longer than is for the public good, wholly irrespective of all private and personal considerations. It may be that a monopoly for fourteen years, even with a reasonable prospect of extension to twenty-eight, is, under existing circumstances, insufficient; but it may be also that a monopoly for less than fourteen, without any chance of extension at all, would, under a different state of circumstances, suffice. Who shall venture to say, that there would be one invention, more or less, were the term extended or shortened by a year or two? Or who would not prefer a monopoly for a short period, obtained at a small expense, and maintainable by a cheap and summary course of proceeding, to one for a longer period, dearly bought, and attended with some two or three costly and harassing lawsuits? The whole matter is one to be enquired into, and adjusted in the way most likely to bring forth the greatest amount of inventive talent at the least possible concession of monopoly by the public.

And if it be thus in the discretion and power of the state—as it undoubtedly is—to determine whether one term of years or another shall be adopted; to make a short term more valuable to the possessor than a longer one; to grant more monopoly and less encouragement, or more encouragement and less monopoly; if such things be, then what becomes of the pretended question of right? If there were any right in the case, it must be a right for ever, independent of statute, and one which might, in whole or in part, be confiscated, but could not be legally abridged.

The degree of novelty necessary to entitle an invention to the protection of a patent, is well and interestingly illustrated in the following paragraphs:—

"The public USE of an art or invention at any time before the date of the patent in which it is comprised, will also be sufficient to render the patent void. And a public use of an invention is sufficient to avoid a subsequent patent for it for three reasons. *Firstly*, Because the public use of an invention is evidence of the public use of it. *Secondly*, Because the Statute of Monopolies expressly requires, that, an invention granted by patent shall be such as others (than the inventor) at the time of making the patent or grant *do not use;* and, *Thirdly*, Because every patent expressly requires, that the invention comprised in it, shall be new as to the public use of it.

"Thus in *Tennant's* Case, the process invented by the patentee had been in use five or six years before the date of the patent, and it was held that it was therefore not a new invention, and that the patent was void.

"In the case of *Lewis* v. *Marling*, it appeared that the patent, dated January 15, 1818, was, for an invention of an improved shearing machine, for shearing woollen cloths, by means of rotary cutters, shearing from list to list. The defence was, that the mode of shearing by rotary cutters, was not new at the time of the plaintiff's patent, and it was proved, that in the year 1811, a specification was enrolled in *America*, for a machine to shear cloth from list to list by means of rotary cutters, and, that in that year a model of an exactly similar machine was *brought* to *England*, and exhibited to three or four persons. It was also proved that in the year 1811, Mr. Thomson, a manufacturer, in *Yorkshire*, employed workmen, to make a machine from the *American* specification, and that they had set about it. But in consequence of the Luddite riots, Mr. Thomson was afraid to have it completed. *Lord Tenterden*, C.J., said to the jury, 'To show that the machine was not new, evidence is given that a model has been seen by three or four persons, and that the making of a similar machine was begun; but it appears to me that the defendant has failed to prove that such a machine was *generally* known, or *generally* used in *England*, before the taking out of this patent by the plaintiffs,' and there was a verdict for the plaintiffs.

"This statement of the case of *Lewis* v. *Marling* is in accordance with the report of it contained in the fourth volume of the Reports of Messrs. Carrington and Payne. But upon a subsequent motion in the Court of King's Bench for a new trial in this case, *Lord Tenterden*, C. J., said that he had left it to the jury to say whether the invention 'had been in *public* use and operation before the granting of the patent;' and it does not appear that any objection was made to the charge of *Lord Tenterden* to the jury on the ground that the learned judge used the expressions, 'generally known' and 'generally used,' instead of 'publicly known' and 'publicly used.' There can be no doubt, however, that it would be a mistake to say that an invention must be generally known or used in order to avoid a subsequent grant of it by patent, it is sufficient if it was publicly known or used before the date of the patent.

"*Mr. Baron Alderson*, upon the argument of one case said, that 'the case of *Lewis* v. *Marling* went to the extreme point of the law.' And upon another occasion, that in the case of *Lewis* v. *Marling* he should have entertained very considerable doubts.

"So in the case of *Cornish* v. *Keene*, at Nisi Prius, the *Lord Chief Justice Tindal* told the jury, that if the invention was, at the time the patent was granted, in any degree of general use—if it was known to the world publicly, or practised openly, so that any other person might have the means of acquiring the knowledge of it as well as the patentee, then the patent would be void.

"The recent case of *Carpenter* v. *Smith* shows most clearly the meaning of the expression 'public use' when applied to an invention. That case was an action for the infringement of a patent for improvements in locks, and it was shown that a lock substantially the same as the plaintiff's had been put upon a gate in a public place, and used by Mr. Davies for many years before the date of the patent. Upon the trial of the case at Nisi Prius, *Lord Abinger*, C. B., said that 'public use' means this—that the use shall not be secret, but public; and that the use

of the lock by Mr. Davies on his gate was a public use of it within the meaning of the clause in the patent, which requires the invention to be new as to the public use and exercise of it.

"His Lordship also said, 'If a man invents a lock, and puts it on his own gate, and has used it for a dozen years, that is a public use of it. If it were otherwise, see what the consequence would be; Mr. Davies has a lock, which he has directed to be made and put upon his gate sixteen years ago at least; if that was not a public use of it which prevented a man from taking out a patent, any man might go and take a model of that lock and get a patent for it,' and the learned judge also held, that 'public use and exercise' does not mean a use or exercise by the public, but a use or exercise *in a public manner*, and that such a use of an invention by *one* person would be sufficient to avoid a subsequent patent for it.

"The jury in this case having found a verdict for the defendant, the plaintiff moved for a new trial on the ground of misdirection by the *Lord Chief Baron* to the jury, but the Court of Exchequer refused to grant even a rule nisi. *Mr. Baron Alderson* said, in giving judgment in this case, 'Public use means a use in public, so as to come to the knowledge of others than the inventor, as contradistinguished from the use of it by himself in his chamber. How, then, can it be contended that the lock which has been used in public by Mr. Davies for so many years is a new invention? If the plaintiff's doctrine is correct, it would follow that if Mr. Davies were to change his lock to another gate he would be liable to an action for an infringement of the plaintiff's patent.' And *Lord Abinger* again said, that 'the public use and exercise of an invention means a use and exercise *in* public, not by the public.'"

We cannot so readily subscribe to what follows:—

"The public sale of an article, made according to an art or an invention, will also invalidate a subsequent patent, granting the sole use of such art or invention. Such a public sale seems substantially the same as a prior public use or exercise of the invention; and if once a person has commenced the use of an art or invention, and made a profit of it by public sale, it would be unjust to deprive him of the benefit which he is reaping from such an application of his labour or capital.

"In the case of *Wood* v. *Zimmer*, it appeared, that the patent was for a new mode of making verdigris, to be called, *British* Imperial Verdigris. It appeared also, that the patentees had sold an article, composed precisely in the same manner as that for which the patent had been obtained, under the name of *Dutch* Imperial Green. *Lord Chief Justice Gibbs*, said to the jury, with reference to the question of novelty, 'Some things are obvious as soon as they are made public. Of others, the scientific world may possess itself by analysis. Some inventions almost baffle discovery. But to entitle a man to a patent, the invention must be new to the world. The public sale of that which is afterwards made the subject of a patent, though sold by the inventor only, makes the patent void. It is in evidence that a great quantity was sold in the course of four months, before the patent was obtained; and, that the bankrupts were in the habit of selling this manufacture.' And his lordship left the question to the jury, to say, whether the invention was in public sale before the patent, in which case his lordship thought the patent void, and the jury found the question in the affirmative; and consequently, there was a verdict for the defendant.

"This case was cited and approved of, in the case of *Morgan* v. *Seaward*, in which *Mr. Baron Parke* said, in delivering the judgment of the Court of Exchequer, that, 'If the patentee himself had before constructed machines (made according to the invention) for sale as an article of commerce for gain to himself, and been in the practice of selling them publicly, that is, to any one of the public who would buy; the invention would not be new at the date of the patent. This was laid down in the case of *Wood* v. *Zimmer*, and appears to be founded in reason, for if the inventor could sell his invention, keeping the secret to himself, and when it was likely to be discovered by another, take out the patent, he might have practically a monopoly for a much longer period than fourteen years.'

"In the case of *Losh* v. *Hague*, *Lord Abinger*, C.B., held, that a sale to any one individual, would be sufficient to avoid a subsequent patent.

"The same learned judge held, in *Carpenter* v. *Smith*, that one instance of a public sale for profit, of articles made according to an invention, is such a public use and exercise of the invention as will invalidate a subsequent patent for it. And, in the case of *Morgan* v. *Seaward*, although the Court of Exchequer decided that the transaction proved in that case, was not such a sale as would defeat a patent; yet expressly guarded themselves against being understood as deciding that a single instance of a sale of an article, as an article of commerce to any one who choose to buy, might not be deemed

the commencement of such a practice, and the public use of the invention, so as to defeat a subsequent patent."

The current of decisions is, no doubt, in favour of the view here given of the law as to the effect of prior sale in establishing prior use; but we think there has been an important distinction overlooked, which must, one day or other, if brought fairly before the courts, lead to a considerable modification of it. It is not every invention which tells its own story—the *art* by which it is constructed, which, as Mr. Hindmarch clearly shows elsewhere, is that alone which constitutes the essence of an invention. The paddle-wheel in the case of Morgan *v.* Seaward, the revolving wheel in that of Lost *v.* Hague, and the lock in that of Carpenter *v.* Smith, had all only to be seen in order to make everything peculiar to them known. But the verdigris in the case of Wood *v.* Zimmer, did not reveal to the eye how it was made; and so far as the mere sale went, it made the public no wiser than it was before. True, "the scientific world" may, as Chief Justice Gibbs said, "possess itself by analysis" of the secret of a chemical composition; but it may also *not* be able to do so: and how the fact was in the particular case cited, does not appear; the question, in fact, seems never to have been raised in this shape. Now, if neither inspection nor analysis can give the art by which an article is produced, how can the sale of that article be said to make the art known to the public? All that the public want to know is left as much in the dark as ever; nor would a thousand or ten thousand sales throw the smallest light upon it. It may be, as Baron Parke observed, that, "if an inventor could sell his invention, keeping the secret to himself, and when it was likely to be discovered by another, take out a patent, he might have practically a monopoly for a much longer period than fourteen years." But what then? The question is not so much what a secret is worth to the inventor, but what it is worth to the public. A man is a possessor of a certain valuable piece of knowledge, which the public are desirous of obtaining from him. Can they extort it from him? No. Can they buy it? Yes. For what? For a fourteen years' certain monopoly. Is a fourteen years' monopoly too great a price to concede for a free use ever after? No. What remains then? You must either pay the price, or go without the secret, and run the risk, besides, of its being lost, through the death of the possessor, for ever.

If the doctrine were sound, that sale constitutes publication, then there could be no secret processes whatever in the arts and manufactures. Now, we all know not only that there are many such processes at the present day, but that such processes have been lost to the world for want of publication (extensive sale and long use, notwithstanding,) beyond all hope of recovery. We need but instance the art of making malleable glass, believed to have been once known to the Venetians. Were such an article as a malleable glass goblet now presented to an admiring world, it would convey no idea of the process by which it was produced, and might, very probably, utterly defy the ingenuity of man to penetrate the secret of its manufacture. Who shall tell us that a secret like this would not be a good subject for a patent? Or who would think of disputing the validity of the patent when obtained, because the goblet happened to be sold before the mode of making it was disclosed?

The "Remedies for the Crown and the Public, by *scire facias*, to repeal void or illegal patents," form the subject of one of Mr. Hindmarch's most original and valuable chapters. He shows clearly that the proceeding by *scire facias* may be taken either to repeal and *cancel*, or simply to revoke a patent, though, in point of fact "there is no instance in modern times of the determination of a patent" by the latter method; and that, when the *scire facias* runs in the former or usual form, it is not enough that there should be a verdict for the Crown obtained in the Court of Queen's Bench, but that the verdict must be returned to Chancery, judgment be entered up there, and either the letters patent be actually cancelled by the Lord Chancellor, or, if through any accident they are not forthcoming, "a vacatur entered on the roll."

We must now take our leave of Mr. Hindmarch, with our best wishes for the success of his work, which, if it only find its way where it is wanted, must soon have a place in the library of every one interested in the law of patents, whether as inventor or patent proprietor—as counsel or client.

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## QUARTER-DECK AND STEAM-ENGINE ROOM TELEGRAPH OF THE ROYAL YACHT "VICTORIA AND ALBERT."

Fig. 1.

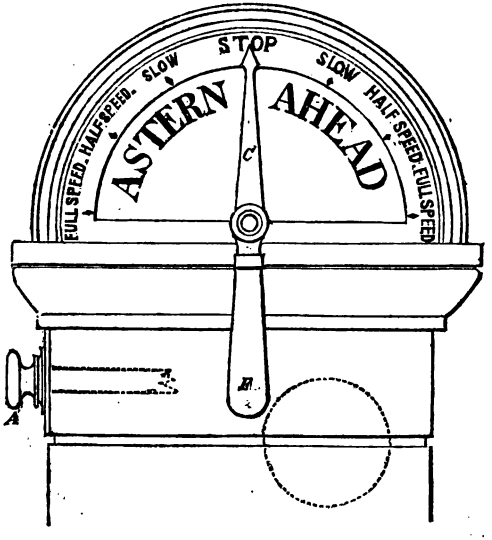



Fig. 2.

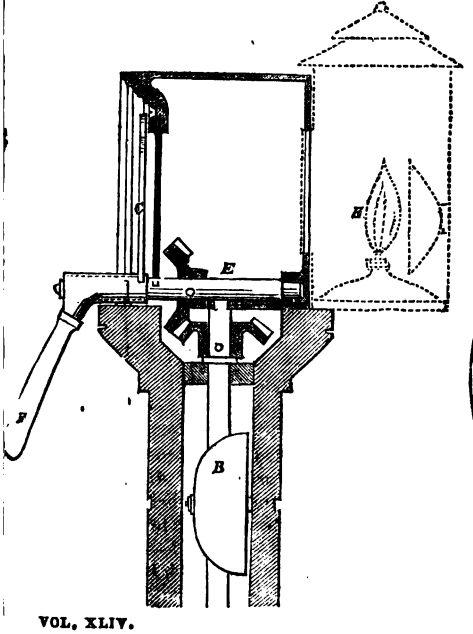
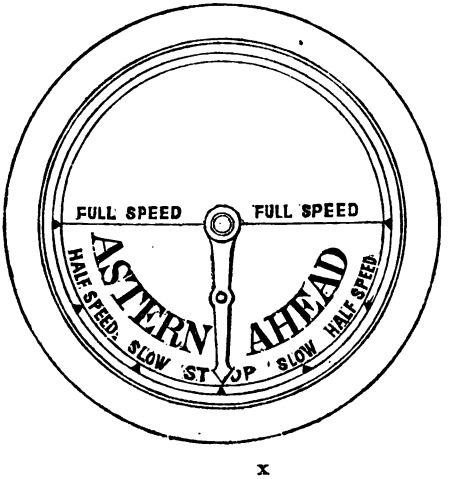



Fig. 3.



### QUARTER-DECK AND STEAM-ENGINE ROOM TELEGRAPH OF THE ROYAL YACHT "VICTORIA AND ALBERT."

THE prefixed engravings represent the apparatus adopted in the Royal Yacht, *Victoria and Albert*, to communicate those orders from the quarter-deck to the steam-engine room, which are in other vessels ordinarily conveyed by call-boys, much to the annoyance of every quiet-loving person on board, and at the serious risk always of the orders given being misrepresented or misunderstood. We may reasonably presume from its adoption in a vessel devoted to the service of the highest personages in the realm, that it is considered the very best which has been yet proposed for the purpose. A patent for it was granted some time ago to Mr. J. G. Hughes, but it has been since much simplified by Captain Crispin, the Commander of the Royal Yacht, whose improved edition of it is that which we now present to our readers.*

Fig. 1 represents a front elevation, and fig. 2, a cross section of the quarter-deck portion of the apparatus, which is mounted on a pedestal near the stern. Fig. 3 is a front view of the engine-room dial.

A is a handle, which being moved agitates a bell in the engine-room in order to call the engineer's attention to the orders to be given.

B is a bell, which the engineer rings to show that he is on the alert.

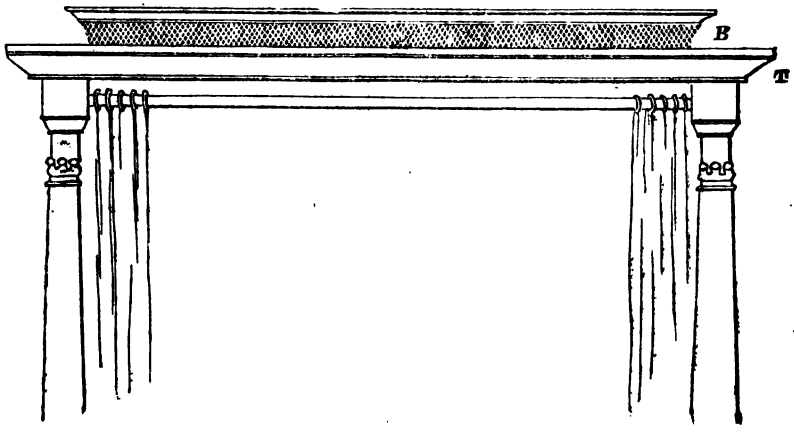
C is a pointers, moved by a handle, F, which communicates by means of mitre wheels, E, with the pointer of the dial (fig. 3) in the engine-room.

The pointers of the two dials are so connected as to stand at similar points on their respective dials.

The centre portion of the quarter-deck dial, on which the words "Astern" and "Ahead" are painted, is of ground glass, and is illuminated at night by means of a lantern, which is removed during the day.

### WAKELING'S VENTILATING BED TOP.

[Registered under the Act for the Protection of Articles of Utility. Messrs. Wakeling and Son, Admiralty Upholsterers, Gerard-street, Soho, Inventors and Proprietors.]




We see here another novelty, which the very proper anxiety of our naval authorities, to study the health and comfort of their Royal Mistress and her Illustrious Consort has introduced into the fittings-up of the *Victoria and Albert Yacht*. The royal bed, instead of being closed at top, as usual, has a double tester (T), or

* The *Scourge* steamer is also fitting out with an apparatus of the same description. Mr. J. Allen, of Bower-street, Commercial-road, is the manufacturer.

a tester made in two parts, one raised above the other, and connected by open trellis-work of brass, B, through which, on the curtains being drawn, the air, as it becomes heated, has a free escape. The Royal example is very likely to make this sort of construction the fashion; but there is merit enough in it, independently of all fashion, to make it deserving of general adoption.

## ON THE MAGNITUDE, FORM, AND PROPERTIES OF SHIPS. BY WM. WALKER, ESQ., R.N., QUEEN'S HARBOUR MASTER, PLYMOUTH.

The prosperity of a maritime people depends in a great measure upon the efficiency of its mercantile marine. By official returns it appears we have 28,692 registered ships, making a tonnage of 3,311,538, at an estimated value of 25,000,000*l.* Now ships are built of perishable materials; they require frequent repairs, and are liable to very many casualties, independent of natural decay. I think we may estimate the amount of money laid out on shipping in this country every year at not less than 4,000,000*l.*

The actual cost of a new ship will depend upon the quantity and cost of the materials required for her construction and the charges for workmanship. It therefore is a matter of primary consideration to make the most of our means, and to give our merchant ships an efficient and profitable form. The materials we are able to buy, should be moulded into such a form (other things considered) so that our ships should have a *maximum* of capacity at a *minimum* of expense. Ships are built of almost every kind of form to meet the conditions for which they are intended. A builder may be limited to length, breadth, or draught of water, but he generally exercises a discretionary power in varying his curves, or other linear dimensions; and he but too frequently exercises this power without being able to give a *reason* for his rules!

Our ships are, in fact, built upon what may be termed imaginary, rather than demonstrable principles! The science of what is generally understood to be naval architecture is not yet very well understood. "Ship-building" *is* very well understood; the various modes of arranging the separate pieces of a ship and fastening them together are matters which may be explained by the theory of practical mechanics; but the *construction of ships*, that is, determining their linear proportions and curvilinear forms, is altogether another thing. This branch of knowledge has not yet assumed a *scientific* form.

Sir John Herschel defines science to be "the knowledge of *many*, methodically arranged so as to be attainable by *one*." Now the *laws* upon which the properties of our sea-going ships are dependent, do not rest upon simple mechanical laws; but on hydrostatics, hydrodynamics, pneumatics, as well as upon gravity, buoyancy, or levity, &c. The fundamental laws of these departments of knowledge, which are applicable to ships, have never been collected and methodically arranged into a scientific form; so that a single naval constructor might be enabled to form his ships without any risk of failure in predicting their capabilities. There is no encouragement in this country for persons possessing the necessary qualification to enter into this *scientific* and *methodical* arrangement! We lay out about 4,000,000*l.* per annum on ships, and ship-builders follow out their own views in forming their models, without being able to give very satisfactory reasons for their opinions. Successful builders, if they do know what they are about, keep their principles to themselves, and of course benefit thereby. The "art and *mystery* of ship-building" they reserve to themselves. But if the public lay out 10,000*l.*, or 11,000*l. daily* upon ships for the mercantile traffic of the country, surely it is of consequence to enquire if there be not some *linear proportional dimensions* of ships *better than any other*; and if it can be shown that there are such proportional dimensions, their general adoption will follow as a matter of course.

It may be agreeable to some of your readers to know a few of the fundamental truths, or axioms, upon which the properties of ships are dependent. Some of these axioms will be received at once as matter of fact. Others may require proof:—

1st. The *weight* of a floating body, and the *weight* of the water it displaces, are equal to one another.

2nd. A solid when placed in any fluid will either float in it, sink to the bottom,

or remain at rest in the fluid. If the solid be heavier than an equal *volume* of the fluid, it will sink to the bottom; if lighter, it will float. If it be of the same specific gravity as the fluid, it will neither sink nor swim.

3rd. Similar ships of unequal magnitudes are to each other as the cubes of their linear dimensions.

4th. The surfaces of similar ships are to one another as the squares of their linear dimensions.

5th. The stability of similar ships of unequal magnitudes are to one another as the fourth power of their linear dimensions.

6th. If the length of a ship be augmented, the capacity and stability will be augmented in the *direct* ratio of the length.

7th. If the breadth of a ship be augmented, the capacity will be augmented in the direct ratio of the breadth, but the *stability* will be augmented *as the cube of the breadth.*

8th. The form, magnitude, and weight of a ship being given, her displacement, stability, and buoyancy will vary with the density of water in which she floats.

9th. Among all the depths to which any ship may be immersed in the water, there is one depth at which she will carry more sail than at any other depth. (*Cæteris paribus.*) The stability is a *maximum* when the immersion is equal to half the magnitude, or when the specific gravity of the ship (regarded as a solid) is to the specific gravity of the water as 1 : 2.

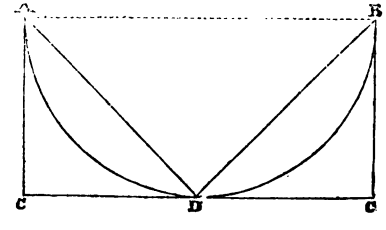
10th. When a sum of money or quantity of materials is given for building any vessel of a given length, her capacity to contain or to carry a cargo *is a maximum* when the breadth is made to the depth in the ratio of 2 : 1.

The above ratio is not only true of ships, boats, barges, &c., but is also true of every kind of vessel whatever. If we wish to obtain a *maximum* of capacity with a *minimum* of materials, in a tea-cup, basin, washing-tray, or any other vessel, we must make the breadth equal to twice the depth. It is a property of a sphere to possess a *maximum* of solidity, with a *minimum* of surface. It is a property of the circle to surround a *maximum* area with a *minimum* of boundary line.

In rectangular enclosures, the area of a square is *greater* in proportion to its sides than any rectangular parallelogram of the same *lineal dimensions.* These are mathematical *facts*, and may be applied with advantage to useful purposes, not only in erecting edifices, or making enclosures on shore, but shipbuilding.

Let fig. 1 represent three forms of midship section of ships, viz., a triangular, circular, and rectangular form. The boundary lines of these sections will represent the frame timber and the plank fastening, &c., of each form; that is to say, the *quantity of materials* that would be required for each particular form would be *proportional* to the *lines* bounding each form. I am now to prove by common arithmetic, that the area of the midship section, or internal capacity of these separate forms, is a maximum, when the breadth, A B, is to the depth, B C, as 2 : 1.

Fig. 1.




| | Linear Dimensions. | |
|---|---|---|
| Circular | = | 62·83 feet |
| Square | = | 80 ,, |
| Root | = | 56 ,, |
| | Area. | |
| Circular | = | 628·32 sq. feet. |
| Square | = | 800 ,, |
| Angular | = | 400 ,, |

Let A C C B be the midship-section of a river barge; A B, the breadth = 40 feet; and A C, the depth = 20 feet; the linear dimensions of the bottom and sides = 80 feet, and the area = 40 × 20 = 800 square feet; these linear dimensions, or *materials* being given, the area of midship section is a maximum.

If it be not, augment, if possible, the area by *encreasing* the breadth, say to 41 feet: then the depth would be 19½ ft.; but 41 × 19½ = 799½, that is, *less* than 800.

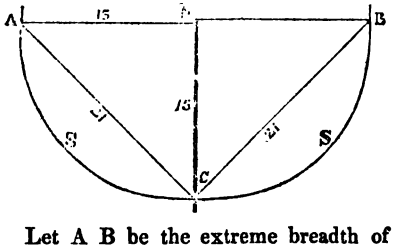
Again: Augment, if possible, the internal capacity by diminishing the breadth, and increasing the depth of hold. Make the breadth 39 feet and the depth $20\frac{1}{2}$. We then obtain $39 \times 20\frac{1}{2} = 799\frac{1}{2}$ square feet, that is, *less* than 800.

The angular, or sharp-bottomed vessel, A B D, has the same breadth and depth as A C C B, and has only half its capacity; for the area of a triangle is half the area of a parallelogram upon the same base and between the same parallels; and in the same manner it may be proved, arithmetically, that any deviation in the form of this vessel's relative breadth to depth, would be attended with a loss of *internal capacity*.

The semicircular vessel has a breadth equal to the diameter of the circle, and its depth is equal to the radius, and any alteration in its form would be followed by a decrease in its sectional area. (*Vide* Properties of the Circle.)

When a naval constructor puts on paper a drawing of a vessel he intends to build, his curves are drawn *within perpendiculars*. As for example, between A C, and B C, fig. 1. Now a vast number of curvilinear midship sectional forms may be drawn between the perpendiculars A C, or B C, and the diagonal lines, A D, and B D; in fact, these possible forms may include all kinds of midship section, from the perfectly flat floor to the sharpest-bottomed vessels. Now the principle laid down in axiom 10, and propounded as above, will be true of all possible curvilinear forms of midship sections. This assertion requires further proof. Let fig. 2 represent a midship section of a merchant vessel, and let the curve of side and length of frame timber be that *selected* and *approved* by the constructor. The internal capacity of this vessel will be a maximum when the breadth of beam is made equal to twice the depth of hold.

Fig. 2.




Let A B be the extreme breadth of the vessel, say 30 feet. Let C *b* be the depth of hold from the plane of the deck to the upper part of the keel at C = 15 ft. Let the frame timbers, B S C, and A C S, be *inflexible in form* and *unchangeable in length*, but moveable on the point C; so that the *breadth* of the ship may be increased or diminished, by throwing the ship's frame either *in* or *out*. Join A C, then A *b* = C *b*, and A *b* C is a right angle. The area of the half section, A S C, *b*, is equal to the area of the right-angled triangle, A *b* C, plus the space S, contained between the straight line, A C, and curved side, A S C. The area of the triangle, A *b* C $= \frac{15 \times 15}{2} = 112\frac{1}{2}$; therefore, the area of the whole half section is equal to $112\frac{1}{2}$, plus the space S aforesaid.

By 47 Prop. of Book 1st of the Elements, $Ab^2 + Cb^2 = AC^2$, or in figures, $15^2 + 15^2 = 450$ = the square of the diagonal, A C.

Let us diminish the breadth of the ship (fig. 2) by making B *b* $14\frac{1}{2}$ feet, and augmenting the depth of hold to 15·48 + feet; the curve of side and diagonal, B C, remaining the same. Then for the area of this altered section, we have B $C^2 - 14\frac{1}{2}^2$ = the square of the increased depth, or $450 - 210{\cdot}25 = 239{\cdot}75 =$ and $\sqrt{239{\cdot}75} = 15{\cdot}48$ feet, or the *new depth* of hold that the vessel would require by reducing the breadth and augmenting the depth, *preserving the form and dimensions* of the timber frame.

The capacity of this half section is equal area of triangle, *b* B C + the space S; or $\frac{15{\cdot}48 \times 14{\cdot}5}{2} + S = 112{\cdot}23 + S$; that is, as less than 112·5 + S. In the same manner it may be proved that a diminution in the capacity of the hold would be made by encreasing the breadth and making it *greater* than double the depth of hold, whatever the curvature of side or area of the space S may be. This *important principle* is dependent on the 5th Proposition of the 2nd Book of Euclid's Elements, where it is demonstrated, that if a line be divided into two equal parts, and also into two unequal parts, the square of half the line is *greater* than the rectangle of the two unequal parts. Almost the whole of our *merchant ships* are too narrow for their depth, they are *crank*, draw too much water, and do not carry so much cargo as they would do if their form, or rather their dimensions, were in

the proportion I have shown to be *the best*. It could be easily shown, that the power of carrying sail is *also* a *maximum* when the breadth is made double the depth. Our ignorance of these principles has prevented us from moulding our ships into those linear proportions which are better than any other; and the prejudice of those who are incapable of investigating the truth of the principles I have briefly noticed, will probably prolong the practice: but the present system of computing the tonnage of ships no longer holds out any inducement for the merchant to augment depth and diminish breadth! The internal capacity is now *cubed*, or actually measured; depth is now involved in the calculation of tonnage, and therefore it will be advantageous for a shipowner to *order* his ships to be of such *linear proportions* as to afford him a *maximum* of freight for the money he lays out in ship-building.

The builder may stick to his old tonnage rules, but if he will consult his own interest, *he too* would certainly gain by so forming the vessel he wishes to sell, by making her as large as possible with the materials he may have at his disposal. The present system of building narrow and deep merchant ships, makes them in many respects inferior to foreign vessels, (the Swedish for example;) they require a great deal of ballast when otherwise empty, and frequently a great deal of ballast when otherwise full! Timber ships, in consequence of their narrowness and deepness, *require* ballast under their timber; and even *with this ballast* they turn over when the water gets at the floaty materials within them. If they were twice as wide as they are made deep, timber ships would not require any ballast under their *cargo*, and very little ballast without a cargo; all the expense of ballasting and unballasting, and the *time* wasted in these operations, would be saved to the owners, and the ships made of easier draught of water, faster sailers, and in every way more profitable vessels.

WILLIAM WALKER,
Master, R.N.

Plymouth, March 22, 1846.

## THE SEPTENARY SYSTEM—MR. JOPLING IN REPLY TO "CENTURION"

"It is the separation of *theory* and *practice* which has brought reproach upon both. Their union alone can elevate them to their true dignity and value."

Sir,—In October 1828, seventeen years and a half ago, (vol. x. p. 150,) I submitted a curve for the consideration of your mathematical readers, which may now serve "Centurion" for his first effort. Perhaps you will have the goodness to reprint that paper, as a supplement to this communication. No doubt many of your present readers never saw that volume, and may not now be able to procure it.*

If "Centurion" will have the goodness to undertake the investigation of that line, and shew how to obtain any variety of that line, he will also, perhaps, be kind enough to describe the characters of the lines of the cusps of that motion, which the intersections of the cranks produced will point out, and further, also, determine the lines of symmetricals, &c., belonging to that motion and its reciprocal, as I have attempted in another example to explain, (vol. xiii. page 228,) showing the number of distinct fields on each plain.

As "Centurion" only alludes to two pamphlets, I suppose he may not have seen a "third;" nor does it at all appear that he is acquainted with all the papers you have published relating to the Septenary System.

Before proceeding with his proffered investigation, he will allow me to ask—may not the line of stability be clothed by a line of beauty, *or by one of more easy generation*, without affecting stability? Is it necessary to have "four centred" depressed arches to ensure stability?

I am glad to hear "Centurion" say, that he concurs with Professor Cockerell, and which has been my own opinion and object to point out for many a long year, however imperfectly I may have expressed my opinion, that there is a necessity for a more extensive practical knowledge of mathematical curves—a more extensive knowledge of the practical means by which geometrical lines can be correctly and with facility described on a large as well as to a minute scale. As for example, to the profile of the column of the Parthenon or any other column—or to any lancet or depressed gothic arch, of whatever dimensions.

Whether Mr. Penrose is correct as to the curve of the column of the Parthenon being an hyperbola, I have no means of judging; but I would suggest, that it should be described of full dimensions with the greatest possible accuracy, and

* The paper referred to is subjoined.

the measurements recorded, on the floor of a gallery in the British Museum. And, as a conchoidal line has been supposed to have been applied for such purposes, I would further suggest, that a line of that character also should be drawn by the side of the hyperbola; by which means the difference in their character, their greater or less degree of coincidence with the actual points found by measurement, and the comparative simplicity of the means by which each different line may be more accurately described by continuous motion, may become practically known and permanently recorded. It is now more than *half a century* since "Stuart and Reveley" visited Greece. The latter, in reference to this subject, in one place says, "The columns diminish from the bottom by a beautiful curve line." In another place, "The columns rise with considerable diminution in the most graceful sweeping lines."

Is it not high time that the nature of these curves, and the methods of producing them on so large a scale, should be practically determined? "Centurion" may better understand what I mean by equations not giving the distinct notion of any curve, by trying to sketch a few, and then refer to correct examples, and compare his sketches with them. I have long known that equations exhibit the changes in the direction of curves to the mind; and I also know that the best hand in sketching from equations can only produce caricatures of the lines.

If the equations could give that correct knowledge and feeling, if I may so express it, of a curve, as to enable mathematicians to sketch and design from equations with accuracy, without having seen the lines drawn by continuous motion or correctly projected, ought they not to be able to know the equation from seeing a curve correctly drawn?

It is admitted on all hands, that all the graceful curves introduced by the Greeks are geometrical lines, or parts of geometrical lines. Can "Centurion," from equations only, determine what lines, or parts of what lines, would produce those various graceful forms?

Is it not that the method of describing a line must be first known, and then the mathematician can investigate it?

There may be a system of curves according to the principles of generation, as well as a system according to their equations. It is to the first the Septenary System belongs; but I doubt not that when thoroughly investigated, there will also be a system of equations corresponding to the Septenary System. I do not say there is no other system; all that I have ever said is that, the Septenary System is practically as definite as the system of conic sections. Nothing would be more easy than combining principle with principle to any extent; but I have defined the Septenary System to extend no further than the regulation of a plane by means of a point or centre; a right line or a circular line, or these simply combined; which may also be said to be the elements of a cone.

If it were in my power I should engage the first-rate mathematicians; linguists best qualified to determine the most simple and appropriate terms for distinguishing both the motions and the lines produced; employ the best designers and draughtsmen; employ the best mathematical instrument-makers to show the various ways of applying the simple principles; employ the best workmen to construct apparatus on a large scale, and show instances of practical applications in civil architecture, engineering, naval architecture, machinery for manufactures, and for designs in general; construct cones, cylinders, cylindrical rings and spheres, and show instances not only of their intersections with planes but also with each other; employ the best engravers, and obtain the assistance of such as could best direct the publication of everything requisite to illustrate the whole in the most complete, yet at the same time in the cheapest possible manner. All this and more I have been recommended by different persons to do myself. "Centurion" will, therefore, excuse me, having other matters to attend to, if I do not try to become either a professor of mathematics or of the classics.

It cannot be expected that mathematicians, or others, should give up their time to such extensive investigations without remuneration. However, I for one will feel much obliged to "Centurion" for any illustration he may effect, however small that may be.

In conclusion, I may observe that the late Dr. O. Gregory, who requires no defence, has given high testimonials of the late Mr. Tredgold. Amongst the rest he says, "Mr. Tredgold is not only a mar

of experience, but also of competent science." Whether, therefore, shall we take the testimony of Dr. O. Gregory or of "Centurion"? To general assertions I make no reply. I am, &c.

JOSEPH JOPLING.

29, Wimpole-street.

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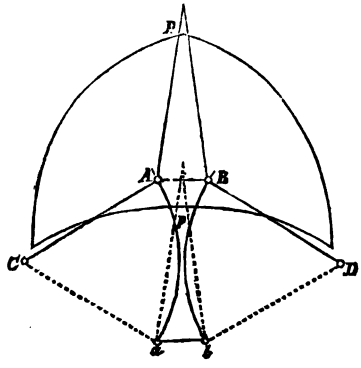
*Extract from the "Mechanics' Magazine" for October* 4, 1828.




Sir,—The accompanying figure is the path of a point P, upon a surface whose motion is regulated by the points A and B, moving in arcs of equal circles, convex towards each other. Let A C, and B D, be two cranks, moving on the fixed centres, C and D, and connected together by A B; the cranks being put in motion, A and B will describe the two arcs. The dotted lines show the position of the cranks, &c. When A has moved to *a*, B to *b*, and P in describing half the curve to *p*. Many of the varieties of figures, with two cusps produced in a similar manner to this, much resemble the moon in her various appearances. Connected with all the varieties, if the point P be placed at a greater distance from A B, than when it describes a line with two cusps, it will describe a line with two nodes, and if at less distance the two horns will be oblated, or rounded off.

In these varieties, the tangents to the curve at the cusps vary from being parallel to their making any angle with each other. There are also, lines that may be selected from examples produced in this way, that in my opinion, are equal in beauty to any semi-elliptical arch of equal span and rise; some of which have points of curvature of infinite radius which may be taken as the springing points; and if a right line be joined to a curve terminating with a point of infinite radius, it will, I should think, form the fairest continuation of line. I do not, as I have stated before, consider that a line of finite curvature and a right line, or curves of different radii, although joined together at the same tangent, form a fair continuation of line. The hope that some of your mathematical correspondents will investigate the properties of curves of this kind, is my inducement for offering this part of the Septenary System to their particular consideration; and the simplicity of constructing an apparatus, together with the beauty of the lines generated, are, I conceive, powerful reasons why they should bestow on it a little of their attention.

I am, Sir, yours, &c.

JOS. JOPLING.

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## FRENCH SHIP-BUILDING AND ENGLISH ENGINE-MAKING.

The *Journal du Havre*, of the 9th instant, announces the safe arrival from the Thames of the iron sea-going steamer *La Finisterre*, built by M. Normand of that place, and engine-fitted by Messrs. Miller, Ravenhill, and Co., of Blackwall. Both vessel and machinery are spoken of in terms of unbounded praise. The vessel being intended to ply as a trader between Havre and Morlaix, both of which are dry harbours, so that at both places she must take the ground at every tide, it has been found necessary to make her stronger than if she were destined to be always afloat; her length and draught have been also, on this account, greatly restricted; yet these drawbacks, notwithstanding, her speed on the voyage out to Havre was, under ordinary circumstances, 12 knots an hour; and against the wind 10 knots. Such a result as this is unquestionably evidence of great judgment and skill on the part of the builder; considering expressly, that *La Finisterre* is the first *seagoing* iron steamer built by M. Normand. Great as the fame of this gentleman as a naval constructor is already, it will not certainly be diminished by this last production of his genius. The engines of *La Finisterre* (of which our French neighbours are honorably liberal of commendation,) are of the oscillating kind, and of 120 horse power; the boilers tubular; and the paddles feathering.

M. Normand is now building for the King of the French an iron yacht, *Le Comte d'Eu*, which is to be 450 h. p., and also an iron tender, which is to be similar to our English tender, the *Fairy*.

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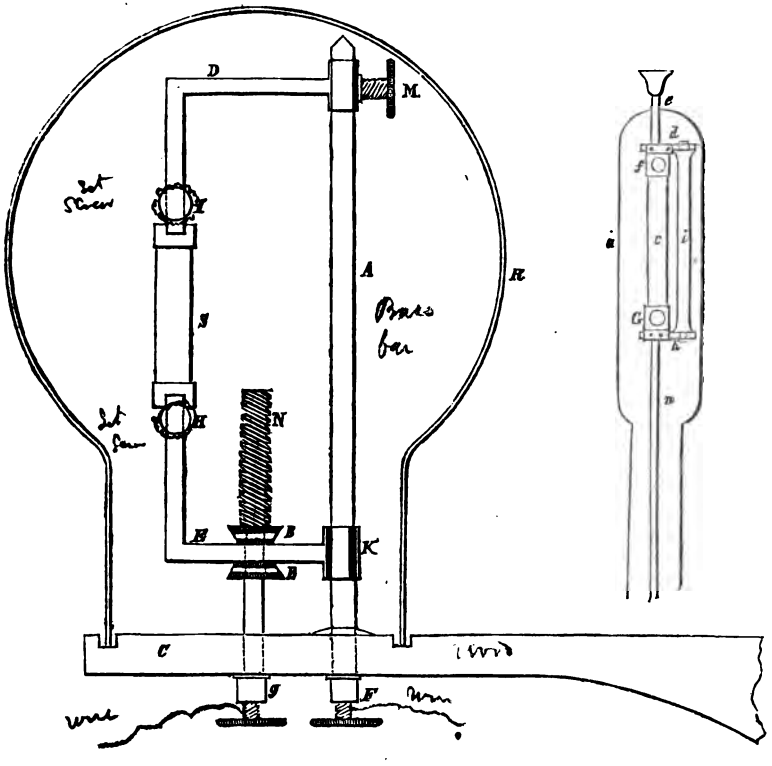
## KING'S PATENT ELECTRIC LIGHT.

[Letters patent for Scotland, dated Nov. 26, 1845; Specification enrolled March 25, 1846.]

The nature of this invention (a communication from abroad,) is described generally as consisting in "the application of continuous metallic and carbon conductors intensely heated by the passage




of a current of electricity to the purposes of illumination. The following details we give nearly in the words of the patentee :—

*Metallic Conductors.*—The metal most advantageous for the purpose, is that which, while it requires very high temperature for its fusion, has but a feeble affinity for oxygen, and offers a great resistance to the passage of an electric current. Platinum, though not so infusible as iridium, has but little affinity for oxygen, and offers a great resistance to the passage of the current; and as it is abundant and easily worked into the required form, it is deemed preferable to any other metal. The platinum should be worked into those exceedingly thin sheets known by the name of leaf platinum. This may be accomplished by the ordinary process of the goldbeater; but a more accurate method is to place a piece of platinum foil between two thick plates of rolled copper, and reduce the whole to a thin sheet by rolling, when on separating the copper pieces, the platinum leaf will be found of uniform thickness in every part. In this way it may be obtained so thin, that on holding it before a printed page, the letters can be distinguished through it. A strip is to be cut from one of these sheets, of a width proportionate to the quantity of the current, which with Daniell's cells, twenty inches high and three inches in diameter, is about one quarter of an inch, and of a length proportionate to the intensity, which of course varies with the number of cells. Great care must be taken to cut the platinum strips of an equal width throughout, and with a clean edge, as, if this is not carefully attended to, the strip will be unequally heated, and will be fused in one part before the other parts have obtained a sufficiently high temperature to produce a brilliant light. The platinum strip is now to be suspended between two forceps in an instrument made for the purpose, one form of which is shown in section in the engraving annexed, and marked No. 1; A is a square brass bar fixed into the

wooden stand C, having a binding screw, F, attached to its lower end. The two arms, E D, are attached to sockets which slide on this bar, so as to admit of their being placed at different distances from each other. They are both bent at right angles, as seen in the figure, and terminated by broad forceps tipped with platinum. These forceps are closed by the milled screws, H I; the arm, C, has a rod, N, with a screw cut on it passing through it, and by means of the two nuts, B B, working on this rod the arm may be adjusted to any required height, and the distance between the forceps thus regulated. The rod passes through the stand and is attached to the binding screw, G. The socket, K, is lined with ivory, or some other non-conducting substance, so as to prevent any metallic communication between the arm E, and the bar; S is the strip of platinum leaf which is first clamped in the upper forceps; the arm, E, is now adjusted to any required height, and the lower forceps are closed so as to clamp the lower end of the strip of platinum. It may now be included in the battery circuit by attaching one of the wires to the binding screw at F, and the other to that at G. The current should be one of considerable intensity, and the distance between the forceps should be sufficient to prevent the platinum being fused. The distance may be lessened by raising the arm E, and shortening the strip of platinum, until it attains the highest temperature it will bear without fusing; or the same object may be attained by increasing the intensity of the current. The glass shade, R, which serves to screen the platinum from currents of air, dust, &c., may then be placed over the apparatus, as seen in fig. 1.

*Carbon Conductors.* When carbon is used it becomes necessary, on account of the affinity this substance has for oxygen at high temperature, to exclude from it air and moisture. To accomplish this in the most perfect manner it should be enclosed in a Torricellian vacuum. One form of the apparatus for this purpose is shown in section in the figure No. 2; *a*, is a glass tube, similar to those used for barometers, except that it has its upper end enlarged into a cylindrical bulb, and a stout platinum wire sealed in at the top. A small cup for holding mercury is fixed on the top of this wire, whose lower end screws in the iron-piece, *d*; to this piece the forceps, *f*, are attached, and it is connected with a similar piece at *h*, by the porcelain rod, *i*. The forceps, *g*, are attached to *h*, and clamp the lower end of the carbon piece, *c*, which has its upper end held by those at *f*; *n* is a copper wire which is fixed into the piece at *h*, and extends to the bottom of the tube; the tube is filled with mercury in the same manner as a barometer—the usual precautions being taken to expel the air; its length, independent of the bulb, should be about thirty inches, so that when it is inserted in a cup of mercury, a vacuum will be formed in the bulb. The instrument is included in the battery circuit, by connecting one of the wires from the battery with the cup fixed on the wire, *e*, and the other with a wire which passes into the mercury in the cup at the bottom of the tube. The circuit is thus completed by the column of mercury, and when it is depressed in the tube by the formation of vapour of mercury in the bulb, the connection is preserved by the copper wire, *n*; that form of carbon on the interior of coal gas retorts, which have long been used, is well suited for this purpose, and it may be worked into the form of either small pencils or thin plates by the aid of the saw and file. As carbon will bear a very high temperature without fusion or volatilization, a much more intense light can be produced by this means than by platinum.

When an intermitting light for light-houses is required, it may be obtained by breaking the circuit at intervals by clock-work; to effect this, one of the wires from the battery is connected with a spring, which is made to press on the circumference of a metallic wheel fixed on one of the arbors of the clock, having certain portions of its surface cut away so as to break and close the circuit at any required intervals. When the apparatus is suitably sealed it may be applied to submarine lighting, and also to the illumination of places where it is necessary to guard against the inflammation of highly combustible or explosive compounds; as in powder magazines, mines, &c. When a current is of sufficient intensity, two or more lights may be made in the same circuit, care being taken to regulate the power by increasing or diminishing the number of cells—if a voltaic battery is the source of electricity, or the number

of armatures—if a magneto-electric machine be used, so that the united resistance of the strips of platinum or carbon shall be sufficient to prevent the passage of such a quantity of electricity as would destroy them.

*The Claim.* "The application of continuous metallic and carbon conductors intensely heated by the passage of a suitably regulated current of electricity to the purposes of illumination as before mentioned."

NOTE BY THE EDITOR.

We fear that the project of lighting by electricity—now a very favourite one with ingenious speculators, and well deserving, doubtless, of every encouragement—is not likely to be much advanced by the present scheme. Both platinum and carbon have been before proposed to be employed as the illuminating bodies or media, and both found objectionable—the former as yielding too feeble a light, and the latter, a light which, though brilliant, is uncertain, and at best of short duration. We subjoin two paragraphs from our common-place book, which may suffice to show, not only the want of novelty in Mr. King's imported invention, but the point at which the labours of men of science in this department have arrived.

"1845, November 8. M. de la Rive is stated in the *Moniteur Industriel*, to have succeeded in obtaining a brilliant light for lighting mines by the galvanic battery. His pile is composed of several concentric cylinders of copper or platina, separated by porous cylinders, and forming a series of four or five couples. An amalgam of liquid zink, or potassium, the positive metal; and a solution of sulphate of copper, for copper cylinders, and chloruret of platina for platina ones. The difficulties in maintaining a constant light have been overcome by employing small hollow cylinders of coke, similar to those used in Bunsen's pile, but smaller, and arranged like the wicks of a lamp, and rings, or discs of metal around these. The electric current passes between the two. The current must be made to pass *from* the coke cylinder, that the particles of carbon, which are carried off, may fall again by their own weight. The whole is placed in a glass globe, which must be hermetically sealed. There is no occasion to form a vacuum in it, as the small portion of oxygen is soon absorbed; but it must be carefully excluded from the outer atmosphere. The pile is fitted with two metallic wires—one communicating with the cylinder of charcoal, and the other with the metallic conductor."

"1845, December 7. Professor Groves, soon after the publication of his nitric acid battery, was struck by the facility and constancy with which the voltaic arc could be obtained by that combination as compared with any previous one, and made many attempts to reduce it to practical form for the purposes of illumination, with, however, only limited success; charcoal, as in M. De la Rive's experiments, formed the terminals of the voltaic pile. Sometimes he could keep a constant light for four or five hours, but it was never sure; from some unseen defect in the charcoal, it would become suddenly extinct; the glass also became dull from carbon vapour which settled upon it: it was costly and not sufficiently portable. There were difficulties which he could not overcome, and he proceeded to experimentalize on another method which struck him as likely to be more applicable to lighting mines; he substituted the voltaic ignition of a platinum wire for the disruptive discharge in place of the charcoal arrangement. The light from the platinum is, doubtless, inferior to the carbon, yet it is too intense for the naked eye to support, and amply sufficient for the miner to work by. His plan was to ignite a coal of platinum wire as near the point of fusion as practicable, in a close vessel of atmospheric air or other gas, and, by the light of which, he states, he has experimented and read for hours, and the apparatus he used was as follows:—At each end of a coil of platinum wire is affixed a copper wire of convenient length, the lower ends of which are to be well varnished, and inserted either through the bottom of a glass vessel, or bent up along its sides, and connected to each end of a nitric acid battery; water is then poured into the vessel, and another glass inverted, over the coil and its supports, which the water thus hermetically seals, and the ignited wire now gives a steady light without any alteration or inconvenience, as long as the battery continues constant—the length of time being of course dependent on the quantity of electrolyte in the battery cells. The spirals of the coil should approximate as near as possible, as each aids by its heat that of its neighbour, and it should be as long as the battery is capable of igniting to a full incandescence. The helix form offers the advantages that the cooling effects being lessened, a much longer wire can be ignited by the same battery; by this increased length of wire the battery fuel is economised, while a greater light is afforded; by the increased heat the resistance is still further increased, and the consumption still further diminished; so that, contrary to the usual result, the incre-

ment of consumption decreases with the exaltation of effect produced. The very necessity of enclosing the coil in a glass recipient also augments the heat, the light, and the resistance. In experiments on the effect of different gases on radiant heat, he found, by filling the vessel with hydrogen, the coil was not even visible in the dark ;an increase of volume by expansion took place from 35 to 43 ; in carbonic acid, cherry-red by daylight, increased from 35 to 43 ; in oxygen, incandescent by daylight, 35 to 45 ; nitrogen the same; and atmospheric air the same as in oxygen. These appear important and satisfactory results, but actual practice on a larger scale can alone test their efficacy."—(*The Mining Journal.*)

## RUTTER'S PRACTICAL OBSERVATIONS ON THE VENTILATION OF GAS-LIGHTS.*

The object of this little pamphlet is to promote the more extensive use of gas-lighting in private dwellings, by combining with it such a system of ventilation, as shall prevent it from overheating, or impairing the salubrity of the apartments where it is employed. It is an extremely seasonable production, and distinguished, like everything proceeding from its author's pen, by great good sense, a very lucid style of explanation, and a constant regard to practical usefulness. Mr. Rutter admits, as needless to be denied, that " apartments lighted by gas are sometimes heated to a most uncomfortable degree, and the air within them rendered exceedingly impure;" but he contends, that these are evils of the easiest possible avoidance.

" In numerous instances, some of which are daily occurring within the sphere of my own observation, and in others which have extended over a period of many years, if the facts were not plain and irrefragable, I should scarcely have believed it possible that so few difficulties were associated with the use of gas in situations and for purposes, which, not many years ago, would have been looked upon as impracticable, or at any rate as highly dangerous, both to life and property. * * * * It matters not what may be the form, the situation, or the dimensions of an apartment, the uses to which it is appropriated, or the number of burners required to light it. If it be lighted with gas, and it be considered desirable to preserve a pure atmosphere, *these objects can be easily and perfectly attained,*" p. 17-19.

Mr. Rutter prefers for the purpose (as is natural) the gas-lamp ventilating apparatus invented by himself in 1843, and manufactured by Messrs. Platow and Co. The reader will find a full description of it in our 39th volume, page 456. It is now in very general use, and does, we believe, fully realize all the good effects ascribed to it.

" By these simple means the perfect ventilation of gas-lights is attained; every particle of heated air, vapour, and deleterious gases being conveyed out of the apartment. At the same time, and as a necessary part of the process, the air at the upper part of the room, which is always the most heated and impure, is quickly withdrawn. A genial temperature and salubrious atmosphere are thus preserved during the whole of the time the lights are burning," p. 24.

We cannot speak of this ventilating apparatus from our own experience; but an intelligent friend, who has had it in use for some time, writes thus to us concerning it: " The light I now write by I kept constantly burning last week for 60 hours; the temperature of the room was not raised 2°, and the difference between the temperature at 5 feet from the floor and at 10 feet was less than 1°. Salubrity and uniformity of temperature are its characteristics."

But whether Mr. Rutter's Ventilating Apparatus or any other be that used, his " Practical Observations" on the general subject will be found equally to the point and equally serviceable. Our advice to all who may contemplate the adoption of gas-lighting in their private dwellings, would be, " Send first for the ' Practical Observations,' and when you have studied them well (but not till then,) set your gas-fitter to work."

* " Practical Observations on the Ventilation of Gas-Lights." By J. O. N. Rutter, Esq., R.A.S., Engineer to the Old Brighton Gas Company. Parker, London; pp. 36; 18mo.

## THE ALTERATIONS TO BE EFFECTED IN THE " GREAT BRITAIN " CONSIDERED, AND THE VIRTUES OF THE SCREW-PROPELLER STILL FURTHER DEVELOPED. BY COMMANDER J. C. HOSEASON, R.N.

" Says Hudibras to Don Fernando,
What can a screw do more than it can do?"

Sir,—When last I had the pleasure of addressing to you a letter upon the properties of the screw-propeller, I had not the advantage which I now possess, of knowing the various opinions of nearly

all the parties who were present during the experimental trips of the *Rattler* and *Alecto;* but I have since had the good fortune to be introduced to many others, who authenticate to the letter every objection raised by me in your Magazine of January 24, 1846. I am therefore not at all astonished to learn that the proprietors of the *Great Britain* deem it necessary to make most important alterations in the masting of that steamer; the nature of which alterations clearly proves that they no longer consider the screw-propeller in any other light than that of a *mere* auxiliary; and thus a steam-vessel which it was affirmed would be the fastest out of the ports of England, will soon, despite her *thousand nominal horses power*, sink into so insignificant a position as hardly to be able to hold her place amongst the American sailing-packets. I should not consider it my *duty* to comment further upon this vessel; but that the baneful influence of the erroneous opinions entertained by the projectors of that *sad* scheme, made converts of others, and induced them to advocate, without sufficient consideration, a too general adoption of the screw-propeller into the navy.

Amongst the manifold mischiefs attendant upon the screw as a propeller, there is one, marked, clear, and decisive; but which, from the nature of the line of argument adopted by me, could not find place in my last letter. I here speak, Sir, of the frightful and dangerous rolling which is the inevitable consequence of this mode of propulsion. Engineers too often hold in sovereign contempt the long-tried experience of the *seaman;* they consider their theoretical notions of the action of a sea upon a steamer as more infallible than the laws of the Medes and Persians; and you may labour in vain to convince them that your practical experience, acquired in every variety of weather, is not to be held in contempt, or despised with *impunity*.

I may safely affirm that *my* profession, *almost* to a man, came very early to the conclusion, that the results of the experiments with screw-propellers were anything but satisfactory; and the most they deemed it right and proper to recommend was, that still further experiments ought to be carried out.

The ruin of a company possessed of a handsome capital, will, I trust, act as a salutary lesson, and induce engineers the more readily to believe for the future, that their theoretical deductions will often be found diametrically opposed to *facts*.

I now hear that the engineers of the Great Western Company hope to make a material decrease of the frightful rolling of the *Great Britain*, by placing whale pieces along each bilge, of 110 feet long, 2 feet wide, and 2 feet deep!! This will most effectually retard the velocity of the *Great Britain* through the water, but will not, I take it, materially decrease her propensity to roll, particularly when under steam, with the wind about two points on the bow.

The simple cause of her terrific rolling is that she is *not* a paddle-wheel steamer; for were she so, the wheels would effectually serve to check so great a defect, for the weather-wheel would require a powerful force to raise it out of the water, and the *lee*-wheel a still greater force to immerse it. thus, then, most powerful counteracting effects would be in full operation to bring within some degree of limitation so dangerous and mischievous a tendency.

It is curious that engineers seem entirely ignorant of the very simple *fact*, that a dismasted ship rolls most dangerously, so much so, that after a general action, it has been hardly possible to stand upon the vessel's deck; now, a steamer in a heavy swell, and *not* under *canvass*, may be likened to a dismasted ship; and nothing but what has been deemed the unsightly paddle-wheels, will be found to counteractso injurious a defect.

I am now in a position to place before you some interesting experiments which have been carried out on board the *Bee* steamer, at Spithead, which is, as you are aware, built so that the engines can work alternately, or even simultaneously, both the screw and the paddle-wheel.

In consequence of my stating in my letter, published in your Magazine, that the screw steamer's engines would be required to be kept *nearly* at a maximum, whatever the velocity of the steamer might be through *the water*, the officers of the Royal Naval College, at Portsmouth, have very properly been carrying out experiments to set so simple a matter at rest. The following is an

extract from a letter, which the writer has received, giving the results of these experiments:—

"Portsmouth, April 4, 1846.

"The screw is now in the *Bee*, and the other day, at Spithead, head to wind and sea, she was going but one knot with 33 revolutions per minute, and with the same wind, had the paddles been on, she would have gone four knots. We tried her with the *expansion* gear on 23 revolutions against a fresh breeze; she went only one quarter of a knot, just holding her own; now with the paddle-wheels, with that number of revolutions, and the same force of wind, (about 5,) she would have gone three knots. When we went before the wind with the *expansion* gear, she went four knots; mark the *slip* of the screw in the case of the steamer going head to wind, when compared to running before it. The experiments I intended to make are vitiated, in consequence of the new screw having too much surface: the engines at full speed only making 34 revolutions per minute, when they should be 40, that being the power of the boiler, and the same that the wheels are proportioned to balance."

Now, Mr. Editor, I wish to point out a simple truth or two deduced from the above experiments, that to obtain a velocity of only one knot per hour against a head sea, the revolutions were forced to be kept up to within *one* of the maximum; and that when the *expansion* gear was put on, with the view to reduce the speed of the engines and economize fuel, *twenty-three cylinders' full of steam per minute were consumed in standing still!!* Oh, most admirable virtues of the screw! Only fancy a steamer burning fuel to all eternity while standing still! This is to the letter all that I have written and predicted of the screw.

Had the patentee of the screw *not* increased its *surface*, the effects would have been even *worse* against a head sea. The following is from another letter from Portsmouth:

"The *Bee's* screw is unshipped to reduce the *surface* of the screw, so that we can work up to the full power of the boiler; of course we shall have a greater per centage of *slip*, more especially when head to wind and sea."

You will perceive, Mr. Editor, from the perusal of the above, that *two* sorts of screws, at least, are necessary to be fitted for each vessel, the one for smooth water, and the other to be used against a *head-wind and sea*.

I have heard that some *frantic schemer* made a proposition to have several different screws fitted, to meet these variable circumstances, the same to be thrown into gear as need might be! Just imagine for a moment, your being under the necessity of stopping your engines in a heavy gale of wind, upon a lee-shore, to ship and unship screws varying in weight from two to four tons!

The *Rattler* on her last cruise unshipped her screw, to place her under sail alone, as she could not steam off a lee-shore, and the following day was not able to ship her screw even in a dead calm! So much for the anticipations of landsmen.

The *Phœnix* screw-steamer in a *moderate* gale, when head to wind, absolutely—so the officers state—*stands and looks at it* — the engines working at heaven knows what number of revolutions, and consuming no end of fuel, standing still! Behold what *science* has effected at last. A steamer of 260 horses power and 800 tons burden, burning away fuel without any limit, and not advancing one foot towards her destination!

I presume, Sir, you have read in the daily papers of the *Massachusett's* auxiliary screw steamer, which vessel was so much eulogized in your Magazine by her owners. She just took forty-two days to perform her *last* voyage to New York; thus demonstratively establishing the *fact* by that, as well as all previous voyages, that her auxiliary screw has only been an effectual retarding power.

I cannot conclude this important letter, written with the single object of eliciting the truth, without clearly and distinctly stating that I am personally unacquainted with every individual connected with the Great Western Company, and also with nearly all the patentees of the screw-propellers, whose interests may be affected by this as well as my former letter. No individual more admires the mass of talent, whose interests are involved, than the writer; nor should I have considered myself called upon to write a single line in your Magazine, but to guard *my* profession against having foisted upon them the erroneous opinions of others. The vessels whose performances I have criticised, have hitherto afforded themes of inexhaustible panegyric—the papers have for more than a year past teemed with most laudatory accounts of their beauti-

ful performances, the public, misled by what they have seen and heard have called aloud for the universal adoption of the screw into the navy—and public lecturers have pointed out the necessity of no further delay. The writer then thought it high time to step forward to rescue his profession from the mischief which its too general adoption would give rise to. His first letter told with fearful effect; this second will settle the question for ever.

"*Magna est veritas et prævalebit.*"

Your obt. servant,

J. C. Hoseason, Commander, R.N.

Army and Navy Club,
St. James's-square. April 22, 1846.

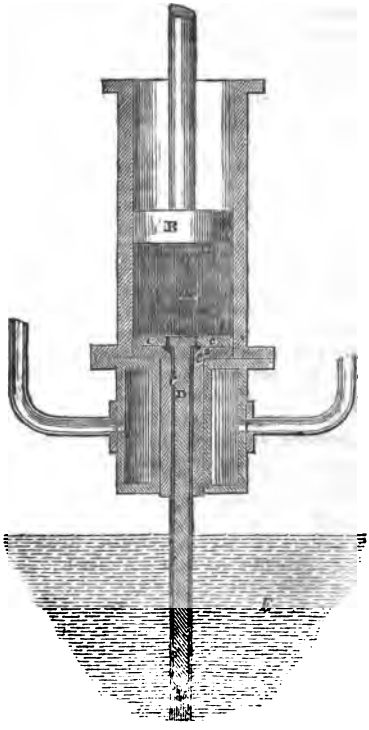
THE GUTTA PERCHA PATENTS. NO. V.

H. Bewley, *for certain improvements in flexible Syringes, Tubes, Bottles, Hose, and other like Vehicles and Vessels.* Patent dated September 4, 1845; Specification enrolled March 4, 1846.

The patentee states, that he employs as the principal element in these improvements "the substance lately first introduced into this country from the East Indies, called gutta percha, and in one or other of the following states." He then proceeds as follows:—

I employ it either in its natural liquid state or in an artificial state of solution, or in a plastic state, or in a sheet state, or in a granular state, or in a state of combination with other substances, one, two, or more, and I either procure it in these states ready for use, or I reduce it to the five states last before mentioned by the means directed to be used for the purpose in the specification of letters patent for England granted to Richard Archibald Brooman, of date the 11th of March, 1845, and in the specification of certain other letters patent for England, granted to the said Richard Archibald Brooman, of date the 27th of March, 1845, with respect to which means themselves I make no claim.

And, *firstly*, I manufacture the said flexible syringes, tubes, hose, and other like vehicles and vessels wholly of gutta percha, in manner following. I either take the gutta percha in a plastic state, and press it into, or upon, and over moulds, of the shape or figure of the vehicle, or vessel, desired to be produced; or I apply it in a liquid state to the exterior surface of suitable moulds, adding one coat after another till the requisite thickness has been obtained, and allowing each coat to dry before another is added, and in this case I make the mould of plaster, or clay, or some other material that will admit of its being broken up after the cast has been obtained; or I pour the gutta percha in a liquid state into suitable moulds, and leave it to solidify; or I fill suitable moulds with the substance in a granular state, and subject these moulds to a heat sufficient to liquify the gutta percha, which on subsequent cooling will be found to retain the exact shape or figure of the moulds; or I cut sheet gutta percha, of a suitable thickness, into strips or pieces, of such given forms, that when combined together vertically, or horizontally, or otherwise, they will form the required vehicle or vessel, and join these strips or pieces together, either by overlapping and cementing, or by cementing them together edge to edge, by heating the edges, or by coating them with a solution of gutta percha, or of caoutchouc, or by compressing them strongly together. Or when making tubes, hose and such like articles, I force gutta percha in a plastic state through an apparatus, such as shown in section in the engraving, where A



represents a cylinder containing the gutta percha; B, a piston; *b*, a die box, kept hot by steam consisting of a disc, *c'*, having a number of holes through which the gutta percha is forced by the piston into a cup, $c^2$, whence it

passes out round a core D, and descends of the desired tubular form into a receiver of cold water, E, beneath; or I make tubes and hose, by rolling one long strip of sheet gutta percha round a mandril in a spiral or other direction, and cementing it together at the edges as aforesaid, either by the application of heat, or of a solution of gutta percha or caoutchouc, or by passing the mandril with the roll of gutta percha wound upon it through grooved rollers, or by immersing the mandril with the gutta percha wound upon it, as aforesaid, in hot water, or subjecting it to the action of hot air for a sufficient time. Should it be desired to give a polished or figured surface to any vessel which has been produced of a plain or dull exterior by any of the said methods, I introduce the vessel into a metal mould made smooth, or figured on the inside as may be required, and force hot water or hot air into the interior of the vessel, so as to press it out against the inner face of the mould, and into every line, hole, or indentation which there may be in it. Gutta percha being a substance which is but little, if at all affected by fat, oils, or grease, or acid fluids, or alkaline fluids, it is peculiarly suitable for the construction of surgical instruments, as catheters, bougies, urinals, &c.

*Secondly*, I manufacture by the same process as aforesaid one or other of them, the said flexible syringes, tubes, hose, and other like vehicles and vessels of gutta percha combined with other substances, one, two, or more; as, for example, combined with cloth or leather, or mixed with more or less of caoutchouc, or sulphur, or French chalk, or ground emery, or asphalte, according as the articles are required to be made softer or harder, or cheaper, or otherwise modified; all as pointed out and explained in the before mentioned specification of Richard Archibald Brooman. And sometimes also I substitute for the sulphur in such combinations an equal quantity of calamine reduced to a state of powder, or use equal portions of calamine.

*Thirdly*, I use the gutta percha both in the simple and mixed states before described, as a coating for flexible syringes, tubes, hose, and other like vehicles and vessels, made in the body thereof of other substances, as caoutchouc leather cloth, &c., in order to render the same impervious to water, or to enable them to resist the action of grease and oils, or of acid or alkaline fluids, and I apply the same either to both the inside and outside, or to the outside only, or to the inside only. The articles may be dipped in a solution of gutta percha, or the gutta percha laid on with a brush or sponge in a liquid state, and in one or more coats, as may be judged expedient; or it may be applied in sheets, cemented to the articles by a solution of gutta percha, or caoutchouc, and joined at the edges by any of the means before described, under the first head of this specification. Tubes and hose of other materials, as aforesaid, may also have a continuous sheathing of gutta percha without joint or break given to them, in manner following: — The tubes and hose are passed through the holes of a steam draw-plate, or box, similar to those used by lead pipe, makers for drawing lead pipes; and these holes, which are of a conical form with the broad end innermost, and are in their least diameter a little larger than the tubes or hose, are kept supplied with gutta percha in a soft or nearly semifluid state, so that as the tubes or hose are drawn through the mass of gutta percha they carry a sheathing of the stuff along with them. To make the gutta percha flow kindly, the steam plate, or box, should be kept at a temperature of about 230°.

*Fourthly*, when caoutchouc has been employed merely as a coating for flexible syringes, tubes, bottles, hose, and other like vehicles, and vessels made of some other material or materials than caoutchouc, I superimpose upon it internally, or externally, a coating of gutta percha, and thereby obviate the stickiness and susceptibility to the action of grease and oils which belong to the caoutchouc in the unprotected state. In this case the gutta percha is best added in a liquid state, and a thin layer of it will suffice.

*Fifthly*, should any of the flexible syringes, tubes, bottles, hose, and other like vehicles and vessels, manufactured by any of the processes aforesaid from gutta percha, in the simple or mixed state, require to have more or less flexibility given to them, I subject them in their manufactured state to the action of sulphur, either by dipping them in a bath of hot sulphur, or exposing them to the fumes of burning sulphur; both as described in the first of the before-mentioned specifications of Richard Archibald Brooman.

And *sixthly*, I make the said flexible syringes, tubes, bottles, hose, and other like vehicles and vessels of a great variety of colours, by mixing with the gutta percha, in the simple or mixed states aforesaid employed in the construction thereof, and however the same may be employed, the pigments or other matters suitable for imparting such colours.

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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

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## MR. WEBB'S IMPROVED METHOD OF VENTILATING SHIPS.

Fig. 1.

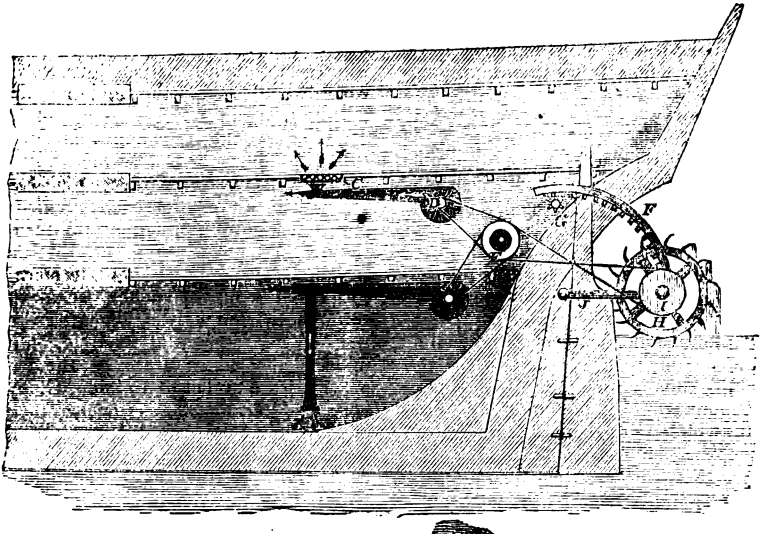
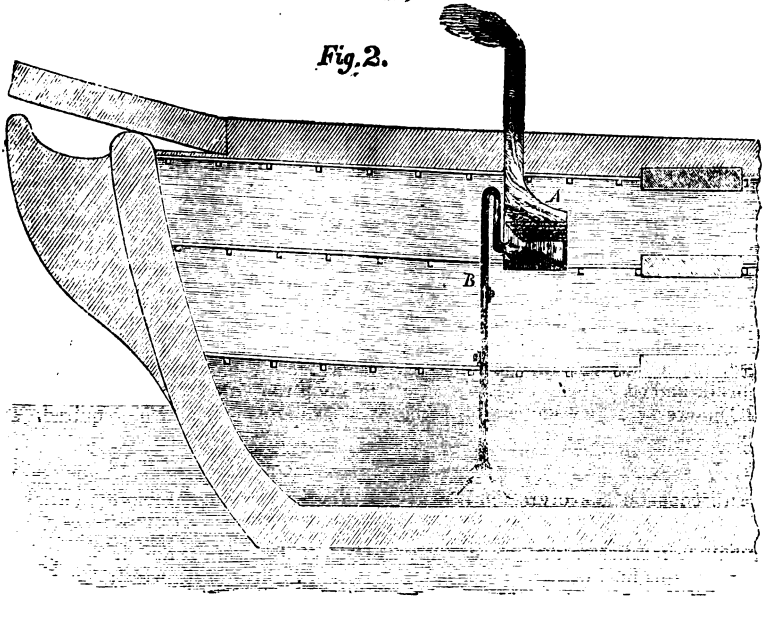



Fig. 2.



## MR. WEBB'S IMPROVED METHOD OF VENTILATING SHIPS.

MR. WEBB, of the Mineral Water Works, Islington-green, London, having had his attention directed to the more effectual ventilation of ships, in consequence of the late melancholy fate of Her Majesty's ship *L'Eclair*, has matured a plan for the purpose, which we now lay before our readers. It has, we understand, been submitted to several distinguished naval officers, by whom it has been highly approved.

### *Description.*

A, fig. 1, represents the fire burning in the ship's cooking stove, but instead of the front being open as usual, it is enclosed by air-tight doors.

B, is a copper pipe connected with the fire-place, and passing down to the bottom of the vessel; the elbow on the top of this pipe is for the purpose of preventing the burning embers from falling down the tube to the bottom of the vessel; this tube is for the purpose of conveying air from the bottom of the ship's hold, which the fire will naturally draw to support its own combustion. Fire cannot exist without a constant supply of fresh air, and in this case the only source of supply is the pipe, the fire-place being enclosed with air-tight doors, which are never opened, except to give a fresh supply of fuel. It follows that as long as the fire is kept burning, so long will the ship be under a state of ventilation, drawing off the impurities arising from the stagnant bilge-water mostly to be found at the bottom of the ship. The arrows show the passage of the current of air. There are two blank union-joints in the tube, which can be detached, and the air drawn from these openings instead of from the hold, which can be used at discretion by closing the bottom of the tube with a damper, and compelling the passage of the air through the openings of the blank unions.

CC, blowers; H, a water-wheel, 4 feet in diameter and 1 foot broad, the centre of which is made to fit easy on a shaft 3 ins. in diameter and 4 feet long, having a key let into the shaft the *whole length;* J, is an iron stay to support the wheel. The currents which pass the ship are so various in different situations that no one rule can be applied, as in some currents the single wheel will be quite sufficient, whereas in other situations four wheels, which would occupy the whole length of the shaft, being 4 feet wide and 4 feet diameter, would be found requisite to work the blowers, C C, which will be almost constantly at work, that is to say, for twenty-two out of twenty-four hours; only ceasing to perform at the turn of the ebbing and flowing of the tide, which is constantly passing the stern of the vessel while at anchor, or moving through the water by sail or otherwise.

F, is the segment of a circle, on the under side of which are cogs, the teeth of which are united to a pinion, G, by a winch, so that the water-wheel by means of the pinion can be lifted out of the water, and its motion instantly stopped or lowered to the depth of water in which the ship is floating.

I, is a drum on the end of the shaft, on which is fixed a band or strap connecting it with another drum E, which drum is connected by means of bands or straps with the two blowers CC, which have four fans, the velocity of which may be increased to almost any extent. Each blower will give a supply of fresh air to any part of the vessel by means of flexible tubes, equal to from 1 to 3,000 gallons of air per minute. The whole of the apparatus, including drums, shaft, and water-wheel, can be unpacked and put in motion in five minutes, and stowed away in the same space of time in a box five feet square. A flexible tube is attached to the blowers to convey the air to any given part of the vessel where a fresh supply of air may be required.

## THE COLLEGE FOR CIVIL ENGINEERS; AND MILITARY SUPERINTENDENCE OF EDUCATION.

It will be recollected that we casually referred to this institution in the *Miscellanea Mathematica*, p. 220, and only casually. This brought a letter from Colonel Jackson, "the first appointed Resident-Director;" which we printed with an editorial note. To this Colonel Jackson again replied in our pages, and

we allowed it to pass *sub silentio*; though we considered that many of his positions were untenable, and that some of his insinuations were, to say the least, illiberal. That letter stands, of course, upon the gallant colonel's own responsibility; and we considered it fairer to take a little time for enquiry before we offered any opinion of our own respecting it. We shall number our topics in order: which is the more necessary as we foresee that the discussion may not be concluded with our present notice.

1. It will be recollected that we stated that the College for Civil Engineers was "founded on the joint-stock principle." We did not make this remark with any invidious intention; but simply to state the facts—that like every other school so founded, the *expectations* of the founders had not been realised; and that, like nearly every other, the "committee of management" had been obliged to resign their functions into the hands of *one* person. Now, whilst the *statement* of Colonel Jackson is an almost unqualified charge of falsehood against us, it very strangely comes out in his own letters that the original scheme had at first "*a most mercenary* character."

We beg of our readers to run over Colonel Jackson's two letters in succession (pp. 236 and 246) and form their own judgment respecting the original scheme, or as he calls it "the first phase of the college." We ask our readers to decide whether we had libelled the institution, so as to call for Colonel Jackson's challenge of our veracity. In fact, had the discourtesy of that remark not been overlooked in the hurry of the moment, we must have been compelled to return his letter. We only refer to it now for the purpose of correcting the apparent anomaly which must at once strike every careful reader of the colonel's first letter and our own remarks.

2. Colonel Jackson gives an account of the preliminary proceedings, which is probably not far from correct in the main, though viewed with a somewhat jaundiced eye. It is most remarkable, however, from the colonel's statement, that *the entire original management embodied not one honest man*—BESIDES HIMSELF! The concern, even after Colonel Jackson had re-modelled it, and infused into the management a due portion of his own honest spirit, was the property, virtually, of one person, and that person an insolvent speculator! Yet even under these circumstances, the high-minded colonel "could accept the office of resident-director, with a salary;"—a salary, too, such that even with the extravagant management of that day he "*submitted* to its curtailment." Yet the colonel is the most disinterested and patriotic soul alive!

3. The colonel urges in proof that the constitution of the "*thing* bore disinterestedness on the very face of it;"—that one decision of the committee expressed that "whatever *profits* may accrue will revert to the institution, to increase its efficiency and extend its usefulness." Now it would be impossible, as it appears to us, to have contrived a more specious form of expression. The term *profit* is admirably calculated to mean anything which it may be found convenient to make it mean. Some simple people may be innocent enough to understand it as the surplus of the revenue over the disbursements; and that these disbursements were made upon fair commercial principles. Colonel Jackson, however, talks of the *quid pro quo* not only for the "money" subscribed after the default of the original proprietor of the concern, but likewise for the "risk" incurred. Such a college was required by the necessities of the times, and no doubt, if well conducted, the "risk" would have been very slight; so that a very moderate addition to the legal interest of five per cent. would have satisfied those gentlemen who adopted Colonel Jackson's fundamental axiom—that the "*thing* must be conceived in the large and truly patriotic spirit of an establishment intended to supply an important desideratum, and confer a great and lasting benefit on the country." But was this liberality really intended to be shown to the public? Did the contemplated moderate *quid pro quo* form the basis of the arrangements? Were not the disbursements *enormously* disproportionate to the value of the assistance and the services rendered? And let it be remembered that Colonel Jackson professes that his "split with the managers" was not founded on anything connected with

the pecuniary question, but upon the mere question of *his own absolutism*. Is Colonel Jackson prepared to state distinctly the real amount of the *quid* and the *quo?* He has chosen to put himself forward (very unnecessarily, we consider, for truly we never thought of *him* in penning our remarks, otherwise than as a cipher in the first semi-abortion of the scheme) as the champion of the college embryo. He has made statements that no one called for, and respecting times and circumstances concerning which no living being, we are convinced, cares a single straw; but having undertaken this Quiotic adventure, he is bound, as a true knight, to answer all challenges respecting the purity of purpose of those with whom he acted. Of the gallant colonel or his exploits, indeed, we know nothing, except that he has gained a little unenviable notoriety in the *Athenæum* for an impertinent letter to the editor of that work; and from which we learn that he is the stipendiary secretary of an embarrassed literary coterie, rejoicing in the name of the *Royal Geographical Society*.

4. We do not belong to that class that considers the *quid pro quo*—if confined to the money for the money's worth—to be any discreditable condition attached to assistance or services rendered. In truth, we consider the man who professes to have any other feeling, to be either an impostor or a simpleton. The labourer is worthy of his hire: every service,—whether to the public at large,—to a mercantile company,—or to an individual,—has, or ought to have, its fair pecuniary reward. It is true, that to some men under certain circumstances, money is less an object than reputation —or an addition to their income of less actual pecuniary value to them than political or social influence. "Every man has his price," said Sir Robert Walpole; and it is seldom, indeed, that even money does not, directly or indirectly, enter into the price of our most patriotic fellow-men. The "motives of pure benevolence," of which the colonel speaks, are, too often, mere professions to "mask some remoter purpose;" and we must be allowed to entertain our suspicions of every profession which so far transcends the ordinary motives that actuate mankind. It is not that a man expects to be rewarded for his services that we condemn him; but that he should profess to expect none, stamps him at once, in our view, as an impostor. His object, indeed, may not be money—but a reward of some kind he expects, and *ought to expect*. It is not that Colonel Jackson and his brother speculators sought their *quid pro quo*, that we take exception; but that whilst extraordinary liberality was professed in their prospectuses, there was sought the bill-discounter's "per shentage, and commission, and brokerage, and etsheteras" upon their *quo*. It is perfectly nauseating!

5. Colonel Jackson repudiates the intention of implying censure upon his successors; and for his own sake we are glad he has done so. We refer to this subject, therefore, merely to notice his views respecting the relative qualifications of military men and civilians "for *superintending* education:"—the colonel considering that, "in *a great many respects, they* [the military men] *are, of all men, the best qualified for the task.*" He then puts forth the insinuation: "If reports are true, the administration in the hands of *a clergyman* was not remarkable for success." Now, as two clergymen have successively followed the two colonels, it would have been but manly and straightforward in the gallant colonel to have stated to which of the two clergymen the article "*a*" is intended to apply, in order that, whichever it be aimed at, he should be able to answer for himself. We do not like these vague inuendos; they smack more of the spirit of the councils, committees, and coteries of our *soi-disant* literary and scientific societies, than of the open honesty to which the soldier so fondly as his peculiar characteristic.

But let us ask wherein consist the peculiar qualifications of the military officer for "superintending education?" Does it consist in the *superior acquirements* of the army-man? Does it consist in a better judgment as to the social, moral, and intellectual training of boys for civil life and civil employments? Does it consist in a more secure selection of proper teachers, lecturers and professors? Does it consist in a system of discipline (founded, of course, on the discipline of the *ranks*) which is so infinitely better fitted for boys of honour-

able feelings and respectable origin? Colonel Jackson has given us his *dictum* —shall we be told that it is unmilitary to furnish his *reasons?*

6. Meanwhile, that we may not leave our readers altogether in the dark as to the answer which *may be* given, we shall state two facts relating to the actual management of this college under a military governor—not Colonel Jackson—but Colonel Hutchinson, (of the Royal Engineers,) which will illustrate this *beau ideal* of "best qualified superintendence:"—

A mathematician of high character and attainments, and a Professor in one of the northern universities, bore a patronymic of historic celebrity, and therefore one very commonly found in Scotland. For obvious reasons we shall designate him by the name of Falkirk. Now, a candidate for a professorship in the College of Civil Engineers bore the same glorious name; and without making the slightest inquiry, and without asking for testimonials or even identification, he was instantly, and with the most ludicrous alacrity, appointed to the chair, as *the* Falkirk! There had been no deception on the part of the candidate. His name and his residence were at once assumed as proof of his identity with the illustrious Falkirk. We ask any sane civilian would he have acted thus? Could any vanity but that of a soldier have led him to suppose the momentary possibility of such a man as the *true* Falkirk offering himself as a candidate in a new institution, under the direction of men whose motives and movements were, to say the least, open to question? But the curious *finale* of this business is, that in a short time "the new star of the college" was *dismissed for incompetence!*

Such is illustration the first of the superior fitness of military officers for the "superintendence of education:" come we now to illustration the second:—

Colonel Hutchinson adopted the practice of attending *parts* of the lectures in college, going in when he pleased and leaving when he chose. The indecorum of walking in and out of a lecture-room in this manner may not be apparent to Colonel Hutchinson, but we apprehend that a civilian gentleman would have viewed it as an act closely allied to absolute insolence. But no matter for this; he was "resident director," and the dignity of his office and the splendour of his army-rank entitled him to *insult his "inferiors."* The mere walking in and out at his own good pleasure was, however, not sufficient. He would not scruple to stop the lecturer in the middle, not of his lecture merely, but of a sentence, and give him a flat contradiction, telling him he was "totally wrong" before the whole class! A fine specimen of the peculiar fitness of a soldier to "superintend education," especially in all that relates to good breeding and high tone of character! Who, besides Colonel Jackson, will contend that such a man was "better fitted" than a civilian for the important, difficult, and responsible office of resident director?

7. It will at once be asked, "Could there exist amongst men of intellect and acquirements, such poltroons as would submit to these coarse indignities?" One gentleman, as we have heard, did hand the chalk to Colonel Hutchinson, telling him to finish the lecture himself, and left the room—we believe for aye and for ever. We commend him. As a general rule, however, the professors who were appointed were either unblushing charlatans, whose very impudence was their passport, or needy *protegés* of the committee, for whom "some good thing must be had." To these men the most enormous stipends were given, larger by far than the most eminent men are paid in the public service of the country: and full ten times as great as the ordinary money-value that their services would command in the scholastic world. As these salaries were given to men who had never before held any but the most subordinate stations, it is easy to understand that their feelings of honour were not of such delicate texture as to fret them to death or desperation under any "snubbing" of Colonel Hutchinson,—as long as they were *well paid for it.*

8. We have heard sundry vague allusions to "an agreement" between the committee-men singly and their respective *protegés;* the nature of which is familiar enough in ecclesiastical circles, and which was well illustrated in a recent slander-trial on the Home Circuit. These point to one "phase" of the *quid pro quo;* but we will not go further into this subject just now. We have said enough to show what the "*profits* whic

were to revert to the institution to increase its efficiency and extend its usefulness" were likely to be. Instead of any *surplus* for such a purpose, the liabilities of the shareholders were becoming heavier every day; and the disrepute into which the college had sunk itself was thinning it daily of its students without a proportionate supply to fill the vacant places. To use an expressive common-place, "It was all but done up."

9. When the patriotic discounter finds that the "gents" whose autographs ornament the back of his bill, are "going to pieces," one of his first *ruses* is to threaten the one who is more immediately concerned, with instant enforcement of his demand for the "pound of flesh" if he do not procure some other person of "undoubted reputation" to add *his* autograph to the already long list of names. The college creditors were *very* patriotic; and military names and military manœuvres had failed of success. They cared little, we apprehend, about the morality of the students,—the military titles of the resident-director,—the soundness of education,—or the reputation of the school,—apart from its influence upon the income of the undertaking. But *the income was affected;* and hence some new scheme must be devised.

The scheme ultimately adopted was that of appointing a clergyman as the resident-director; as most certainly he would appear the best fitted for the correction of the moral evils against which the complaints were become so loud; and from his being a university-man more likely to know *something* respecting the principles and details of a scientific education.

Upon this new "phase," or as we suppose Colonel Jackson would call it, "sub-phase," we cannot now enter. We shall, however, return to it presently; meanwhile, we shall only express our general impression that a new era in the history of that institution is commenced; and if our anticipations shall be realised by the fact, we can most cordially exclaim, "*esto perpetua!*"

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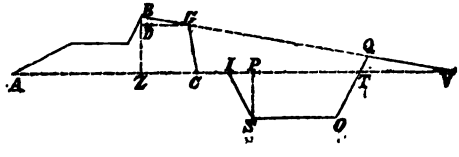
### PROBLEM IN MENSURATION.

Our correspondent "Centurion" writes as follows:—"A young relative of mine, who is preparing for the Royal Military College at Sandhurst, showed me the following very neat problem in Dalby's Course—the work in use in that institution. It appears to me well adapted for the exercise of your junior readers; and if you take the same view of it you will perhaps insert it when you have a vacant corner. I enclose you the solution of it that I drew up for my nephew, merely to enable you with a glance to see its character; but you will probably get a better than mine, on which account it will be desirable not to print it, for a while at least."

Suppose the area of the profile ABGC to be 100 feet; and that the other dimensions be as follows in feet:—

BD = 1,
DG = 6,
BZ = 10,
ZP = 13,
PS = 6, (depth of ditch.)
IP = 3.




What must be the breadth of the ditch, so that its section ISOT shall be equal to the profile ABGC and TQV (the section of the glacis) together; the tubes BG and exterior slope of the glacis QV being in one plane, and slopes IS and TO equal?

*Note.*

We agree with "Centurion" that the problem is a very neat one, and we trust our younger friends will try their skill upon it.

One remark, however, we wish to make to our correspondent, respecting Dalby's Course. That *was* the original Sandhurst work, as Hutton's *was* the original Woolwich one; but precisely at the same time that Hutton was banished from the "Academy," Dalby was dismissed from the "College!" A singular coincidence, *if only accidental.* We have no intention to dwell upon this rude expulsion of the elegant labours of Dalby, Ivory, Lowry, and Wallace, from any department under the control of the Horse Guards. The more valuable such a work, the more likely such a fate!

Our object is to point out to "Centurion" that without loss of time his relative must change his course of study if he do not wish to "get spun" upon his examination. The books used at Sandhurst *now* are those of Professor Scott, and Narrien, very fitting matches for those of Professor Christie. But the use of them is rendered *imperative*, by one of those freaks of irresponsible "authority" that may be witnessed under so many of the public boards in modern times. —ED. M. M.

CENTROLINEATION—MR. FAREY'S ELLIPTOGRAPH AND VANISHING-POINT INSTRUMENT.

Dear Sir,—Your Number 1176 contains (at p. 149) a description of an intrument for drawing lines converging to a distant point, which is very useful in making perspective drawings.

That instrument was invented by me thirty-nine years ago, and after some trials with temporary means, I made the first one in May, 1807, for my own use in preparing the perspective drawings which are well known as mine, in the Cyclopædia, Encyclopædia, Transactions of the Society of Arts, and other publications. In the course of twelve months I made a second instrument, because it frequently proved advantageous to use two at once for the same drawing. These instruments I used constantly, and they enabled me to make perspective drawings on a moderate sized and portable drawing board, with the vanishing points at any required distance.

Dr. Wollaston had recently invented the Camera Lucida, (his patent was dated December 4, 1806,) and I adopted that instrument from the first, with great success, which led to my first acquaintance with that distinguished philosopher. My new vanishing point instruments proved suitable for drawing the converging lines, after their ends and intersections, had been marked on the paper by aid of the camera lucida, in which mode the real vanishing points were not ascertained, as must be done for drawing perspective by rules.

The correctness thus given to the converging lines, could not be matched by tracing the ellipses which occurred in such drawings, and I felt great want of an instrument for drawing the ellipses. Mr. Lowry, who engraved most of my drawings, had one of his own invention, on the principle of the oval chuck, which performed extremely well for tracing ellipses on copper plates (as his engravings testify) but it was not adapted for other use, because the plate revolved in the instrument, as an oval turner's work does in the lathe, and hence Mr. Lowry required a very large instrument for his copper plates, and it would not admit of larger drawings.

I tried many schemes, and constructed various temporary instruments, which I used in my drawings until 1810, when I invented the elliptograph which is known by my name, and made constant use of it in my drawings afterwards. I constructed many such elliptographs for other persons, and received the gold medal of the Society of Arts for the invention in 1813. A description is published in their Transactions, vol. xxxi. p. 117.

In 1814, Mr. Peter Nicholson sent to that society his centrolinead for drawing lines to an inaccessible point; it consisted chiefly of two straight rulers, connected together by two jointed links, somewhat in the manner of a common parallel ruler, but with those two links of unequal lengths, and both connected together by a third intermediate ruler. It was to be used in the manner of a common parallel ruler, by holding one of the main rulers fast on the paper, with its edge directed to the inaccessible centre, and after the links had been adjusted, (with a suitable difference in their lengths,) they caused the edge of the other main ruler to converge to the said centre.

Some members who had seen my vanishing-point instrument, above mentioned, wished to have it brought before the Society. Mr. Nicholson (whom I had never seen before) considered this as an opposition, and spoke with contempt of my instrument, contending that it was no invention at all, but merely an addition of a drawing ruler, to a common carpenter's pocket rule, which any one could make; but he never mentioned having previously thought of doing so himself, and contended for the merit of his own centrolinead. I replied that there was no instrument for the purpose when I first invented and made mine, which I did for real use in practice, and had found it very useful.

Mr. Nicholson received twenty gui-

neas for his centrolinead, and at the same time I received the silver medal of the Society for my instrument. Both are described in the Transactions of the Society, for 1814, (vol. xxxii., pp. 67 and 71) and both are represented in the same engraving (plate 2,) with the following titles over the respective figures—"*Mr. P. Nicholson's centrolinead;*" "*Mr. J. Farey's instrument for drawing lines to an inaccessible centre.*" That plate (2) is signed "M. A. Nicholson, delin."

My instrument there described is the same as in your Magazine, p. 149, except that mine has only one clamping screw for fastening all three rulers together at their proper angles, instead of two such screws. The very first instrument which I made in May, 1807, had two separate clamping screws, but the next instrument had only one, and I found them to answer best in practical use.

After the publication had made the instruments known, mine were enquired for, and several were made by Mr. Cary, in the Strand, but I never heard of any of Mr. Nicholson's centrolineads being made. In 1815, he sent the Society my instrument made with two clamping screws instead of one; and was rewarded with a silver medal. There is a description with an engraving, signed "M. A. Nicholson" in the Transactions, vol. xxxiii., p. 69, and your figure, p. 149, is a copy therefrom.

I made great improvements both in my elliptograph and vanishing point instrument, soon after receiving the medals for each from the Society, so as to greatly expedite drawing in perspective; but becoming too much engaged in other matters to continue that art, I have never yet published them in their improved state, although always intending to do so, as being very useful aids to artists in cases where the camera lucida, (or the Daguerreotype,) cannot be used.

I am, dear Sir, &c.,

JOHN FAREY.

67, Guildford-street, Russel-square,
April 18, 1846.

P.S. I see Mr. Watt's claim to priority of invention, in the expansive working of steam in his own engines, has been brought under discussion in your present volume, (as it was some years ago in another periodical,) in consequence of an expression of doubt, by Mr. Tredgold, who does not appear to have seen the documents from which my opinion was formed, and which are but slightly mentioned in my History, because I did not foresee any dispute on the subject. If Mr. Watt's priority is not admitted to be completely established, (as it appears to be admitted by yourself,) it will be requisite to print the documents in full.

## H.M.S. "GLADIATOR."

On Saturday, the 18th, and again on Saturday the 25th ult. the new government steamer the *Gladiator* went down the river for trial. She is fitted with a pair of direct engines by Messrs. Miller, Ravenhill, & Co., constructed according to the plan for which Mr. Miller obtained a patent two or three years ago. (See *Mech. Mag.*, vol. xxxvi. p. 286.) The cylinders are 78½ inches in diameter; and stroke 5 ft. 9 inches. A prominent feature of the machinery is the placing the air-pumpsin an inclined direction in the centre of the vessel, and working them both from one crank, formed in the intermediate shaft —an arrangement by which a very unusual degree of compactness is obtained. The boilers are tubular, and have Howard's condensing apparatus (claimed also by Symington as his invention) adapted to them. The same injection water is used over and over; that is, continued in a state of constant circulation, through the engines and boilers, and is rendered fit for re-injection by passing through a series of pipes which are exposed (in a tank) to the cooling influence of the sea water, which sea water is kept in constant motion by a double-acting pump, attached to the engines. The *Gladiator* had on the second trial everything on board but her powder, and was consequently at her *extreme load draught*, coals, and all included; and under such circumstances, her speed was certainly remarkable, being not less than 10·66 and 10·75 *knots* or *nautical miles*, against wind. The engines gave pretty uniformly 19 strokes per minute.

## ATKINS'S EQUILIBRIUM WINDOW SASH.

[Registered under the Act for the Protection of Articles of Utility. Thomas Atkins, Gas Engineer, Oxford, Inventor and Proprietor.]

Fig. 1 is an inside view of a window with the parting beads removed; and figs. 2 and 3, both vertical sections through the line *a b* in fig. 1. A is the upper sash, and B the lower one. A line 1 2 3, passes over a pulley C, which is sunk

half its diameter into the upper style of the window-frame, and made fast at either end to the sashes A and B, which are thus caused to balance each other. The pin *c*, upon which the pulley C turns is simply driven into the side-style of the frame; and its outer end (which is flattened) is upheld by the screw, *s*.

Fig. 2.

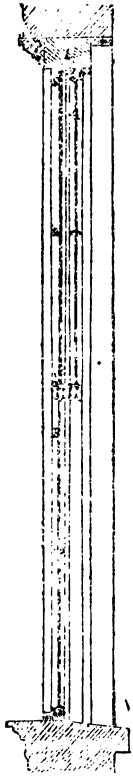


Fig. 3.

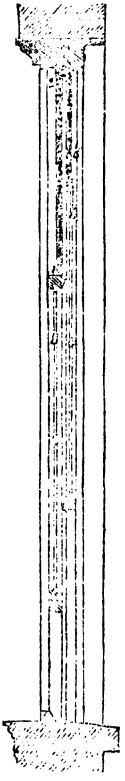
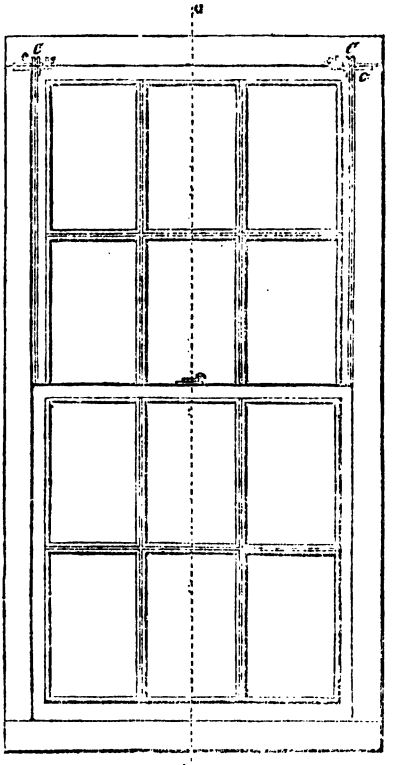


Fig. 1.




A most useful and simple invention—so very simple indeed, that one is amazed to think that it should never have occurred to any one before. We recommend it in a special manner to the attention of the manufacturers of iron houses for exportation, to whom it must be of great importance to get rid of the present troublesome and expensive mode of hanging window sashes.

MR. COLES' ANTI-FRICTION CARRIAGES.—MR. BURSILL IN REPLY TO MR. BADDELEY.

Sir,—Mr. Baddeley's recent observations upon my communication, (No. 1179,) containing a favourable mention of Mr. Coles' anti-friction carriages, being calculated, in my opinion, to strengthen erroneous notions, and to keep up an unfounded prejudice against an invention which sooner or later must prove of marked utility, I must request the indulgence of a few pages of your valuable work to reply to the same.

Mr. Baddeley commences with an objection he made long since, that the anti-friction wheels are not placed in the true line for overcoming the forces to be neutralised; alluding, as he observed in a former Number, to the combined forces of gravity and of traction; and which objection might have been answered long ago, by pointing out that the argument applies with just as much force to an ordinary coach-wheel; for in the same

way that the ordinary coach-wheel is made to support the weight of a carriage, so are the anti-friction wheels employed by M . Coles made to support the superincumbent burthen,—being thus placed with a view to neutralise, or to diminish as much as possible (when in motion) the force of *gravity*. By effecting that diminution, it follows of necessity that they lessen proportionally the required force for *traction*, and as a matter of course, it is only necessary to diminish what may be termed the radial force of gravitation, in order to lessen its tangential force; or, in other words, in proportion as we diminish the weight of an object, we render it more easy to remove that object by traction. And yet, because the forces of gravitation and of traction are radial and tangential, as regards the earth's figure, Mr. Baddeley would have the anti-friction wheels placed neither vertically, nor horizontally, but obliquely; or, in a line between the two. Now what would be the answer of a common mason, were Mr. Baddeley to suggest to him such a position for his rollers, in order to remove a block of marble?

It is true that upon Garnet's principle, where the rollers are fixed in the nave of a wheel which revolves round a fixed axle, every roller is brought in succession at some time or other into what Mr. Baddeley would term the true line, for neutralising the combined forces of traction and of gravity, and sometimes *not*, since the position of such rollers, in relation to these forces, is constantly changing; no wonder, then, that Garnet's principle, notwithstanding its undisputed utility for many purposes, is but ill adapted for heavy railway-carriages. No wonder that where much weight is used, there should be a liability in such rollers to wear the periphery of any wheel or axle around which they revolve into facets: but the rapidity with which such small rollers must necessarily revolve, is itself an objection.

Mr. Baddeley refers to Mr. Roberts, of the firm, I presume, of Sharpe, Roberts, and Co., of Manchester, as having tried numerous experiments on a large scale, with anti-friction wheels, which proved unsuccessful. It is true that Mr. Roberts made many endeavours to reduce friction upon the Liverpool and Manchester line, but most of his experiments will, I believe, be found to have been upon Garnet's principle, as being that which afforded, in his opinion, at that time, the greatest promise. It is true, also, as I have been informed, that a carriage constructed upon that principle, when placed upon the line, ran quite away from all the others for a short space, or until it came to a curve, which it was found very inadequate to work with advantage, and this is a difficulty which applies in an especial manner to anti-friction carriages generally. It is a difficulty, however, which Mr. Coles has, with indefatigable perseverance and ingenuity, in my opinion, in a great measure surmounted.

It is generally agreed, Mr. Baddeley observes, "that by a degree of accuracy of mechanical construction, which is within the present limits of engineering skill, and by a good system of lubrication, the friction of the axle in its bearings may be reduced to an exceedingly small amount,—not more than 5lbs. per ton." This exceedingly small amount, then, is *all that can possibly be saved.*

1. Now surely Mr. Baddeley does not intend to convey to your readers an impression, that to save the whole amount of the friction of the axle in its bearings, or even the half of it, whatever it may be, would *under no circumstances be of advantage?*

2. For if such should really be found to be the case, it would only be doing justice to Mr. Baddeley, to acknowledge that he has the best side of the argument; and so soon as Mr. Baddeley can show, that even for ordinary transit purposes, it matters not whether a given carriage or train of carriages should be loaded with five tons or five hundred, I will willingly make such acknowledgment.

3. Again, that gentleman remarks, "if we admit (for argument's sake) that Mr. Coles' plan would save the whole of it, (that is, the friction,) it requires but little acquaintance with arithmetic to perceive the fallacy of Mr. Coles' statement, that to maintain a given speed, *half the power will be sufficient*, or, with the same power, *twice the speed will be realized.*" I would not have your readers to suppose, Sir, that I am myself so ill-acquainted with arithmetic, or with the laws of mechanics, as to imagine that Mr. Coles, even did he possess the means of doubling the power of the locomotive engine *ad libi-*

*tum*, would, by the same rule, go on continually doubling the speed; neither did Mr. Coles intend to convey any such meaning; but every one knows, that, the lighter the load, the easier and swifter, within certain limits, it is possible to travel.

All are aware that a loaded wagon does not usually run quite so fast as a mail-coach, or a luggage-train as an express; and having clearly demonstrated that he had diminished the required tractive power nine-tenths, or say, if you please, three-fourths only, by reducing to so great an extent the present amount of friction, Mr. Coles had a perfect right to assume, that in some instances, or within certain limits, half the power at present employed would be sufficient to maintain the required speed, or that with the same power that is now employed, twice the speed would in some instances be realized.

"Many attempts," Mr. Baddeley argues, "have been made to reduce the friction of axles by the introduction of anti-friction rollers variously disposed, the design being to convert the rubbing or sliding into a rolling action; but the generality of the contrivances for this purpose have had no other result than the *removal* of the friction from one part to another, and of weakening or encumbering the general structure by a multiplicity of parts."

Nothing can be more true than this,—the great problem in the application of anti-friction principles is undoubtedly to obtain the required end without weakening the general structure; but are your readers to conclude that because the generality of such plans have hitherto proved failures, no importance is to be attached to a principle involving as it does, results, when *successfully conducted*, of so much importance?

It would be easy to multiply instances, but Mr. Baddeley need go no further than the City-road to witness a successful application of the anti-friction principle, to the manufacture of blacklead pencils by the late Mr. Mordan; with the machinery for which purpose, many of your readers are no doubt well acquainted.

"Where," Mr. Baddeley asks, in allusion to the anti-friction carriages, "where are the parallel and identical cases demonstrative of their asserted efficacy?" By these parallel and identical cases is meant, of course, I presume, the cases sufficiently analogous to enable one to form a judgment as to the correctness of such asserted efficacy. Now might not the inventor of these carriages ask with equal justice and propriety, where are the parallel and identical cases demonstrative of failure? For certainly, Coles' plans have never been tried upon an extensive scale, although an attempt was made in America to carry out a plan somewhat similar, but which failed for reasons that can very readily be assigned; in fact, the carriage was not adapted for working a curve, in which respect Mr. Coles' invention differs from all others that I have yet heard of, and in this consists, in great measure, not only the novelty, but also the great promise that is afforded of ultimate utility.

I have myself witnessed various experiments with Coles' anti-friction carriages, and although due and very full allowance should of course be made for the difficulties attendant upon an extensive application of the anti-friction principle—although it is, in fact, impossible almost to be too careful respecting the evidence afforded by model performances, since any error on the wrong side frequently leads to very gross mistakes—yet I am of opinion that the data afforded by the working of the models in question will admit of such ample allowances. Nor was it without first making, as I considered, such ample deductions, that I ventured to eulogise the anti-friction principle in your valuable work as highly adapted for employment upon the atmospheric and magneto-atmospheric railways.

One of Mr. Coles' experiments, with which I was much pleased, was as follows: A model carriage, mounted upon common wheels, and weighted with 140lbs., was placed upon a plane slightly inclined; so slightly indeed that a 3lb. weight carried over a pulley was just sufficient to draw it up. The same carriage was then adapted to the anti-friction principle and loaded as before, when a 7oz. weight was more than sufficient to draw it along the incline in a similar way, and with a 1¼lb. weight it was drawn at *more* than twice the original speed; the 3lb. weight ran quite away with it.

Many other experiments might be enumerated of great promise, more especially as relates to the working of curves; but if I am to infer from the latter part of Mr. Baddeley's communication, that

all model-supported theories are to be regarded as fallacious so long as they are *only* supported by models, however correct such theories may be, or however promising the performances of such models, then the bare possibility of his becoming converted at any time to *my* opinion, must depend upon circumstances quite beyond my control, and it would be a mere waste of time to attempt the accomplishment of any such object through the medium of your valuable columns. But as many of your readers may not be so fastidious as to reject altogether as *fallacious* the evidence afforded by model experiments, I have appended the copy of a paper in my possession with a detailed account of some experiments tried long since (but never yet published) by another party, and which, in justice to Mr. Coles, who is a clever mechanic, you will much oblige me by inserting in your Magazine.*

Before concluding, allow me to thank your correspondent, Mr. Williams, for his obliging answer to the query contained in my communication relating to magneto-atmospheric railways.

I have always been *inclined* to the opinion expressed by Mr. Williams that the magnetic influence, or agency, is communicated in right lines, radiating in all directions from the source whence it originates, and that an intervening substance does not, under ordinary circumstances, cause any divergence from such course. The simple modification suggested by that gentleman (No. 1182) of the well-known magnetic experiment to which I referred, would seem to be conclusive.

The difficulty Mr. Williams has started, however, as to the great difference between the vertical and horizontal force of attraction that is exerted by magnets, or rather, the difference of power that is required to detach a magnet from its keeper, according to the direction in which that force is exerted, (whether perpendicularly, or in a line parallel to the face of the magnet,) seems to me a very important one, and is well worthy the attention of the projectors of the magneto-atmospheric railway, since, although the arrangements that gentleman has proposed will doubtless do much towards meeting such difficulty, it by no means overcomes it completely.

Now had it been found by experiments that the magnetic influence or agency was, under certain circumstances, diverted from its usual rectilineal course as I had somewhat suspected, or were it possible purposely to bring about any such divergence, even though but slightly, by the introduction of any intervening medium or substance, or to in any way influence the direction of such magnetic agency artificially, then I think we might consider that we had advanced a step further, since it would not be difficult to construct a horizontal piston or keeper to a magnet for railroad purposes, which piston should be packed at each end, and having between the packed ends numerous circular plates, the oblique or vertical faces of which should present a widely extended surface for the magnet to act upon.

I merely throw this out as the crudest possible suggestion; for although we know very well that caloric, for example, may readily be reflected, and that the rays of light also may not only be reflected, but are even bent in passing through certain media, as through water, or glass, under certain circumstances; and may be actually concentrated or made to act more powerfully upon a given focus by aid of a convex lens, it by no means follows that the magnetic influence, or agency, or *fluid*,—supposing, indeed, that such fluid should be hereafter proved to have a real existence, can be dealt with in any similar way.

I have adopted the term magnetic influence or agency, in preference to that of magnetic fluid, in deference to the reasons assigned by your correspondent, Mr. Williams; and yet from our at present very limited acquaintance with magnetic phenomena, I think it is at times advantageous to assume the existence of a material fluid; nor is it probable that the term magnetic fluid will become altogether exploded until we are much better informed than at present.

The mere assumption of the existence of phlogiston, gave rise frequently, no doubt, to errors in the speculations of early chemists; and yet from the state of chemical science at that period, I very much question whether, without such assumption, they would have made anything like the same progress, or even been able to render themselves intelligible.

I am, Sir, &c.,

London, April 22, 1846. G. H. BURSILL.

* We shall give these experiments in a future Number.

### DISCOVERY IN LOGARITHMS BY MR. SCOTT RUSSELL.

Sir,—Will you allow me to call the attention of your readers to a recent improvement in the use of logarithms by Mr. John Scott Russell, in his Treatise on the Steam Engine, as reprinted from the "Enc. Britannica." At page 285, in a paragraph on the "Strength of Copper Boiler Plates," occurs the following:—By these experiments the law which connects the diminution of cohesion with the increase of temperature has been accurately determined, and it appears conformable to the following simple expression—

$$\left(\frac{t'}{t}\right)^3=\left(\frac{d'}{d}\right)^2.$$ When,

$$\log.\ d'=\tfrac{3}{2}\ (\log.\ t'-\log.\ t)\ \log.\ d,$$

by means of which the diminution of strength having been ascertained for one temperature, it may be found for every other according to the following rule:—From the logarithm of ($t'$) the temperature (reckoned from 32°) of the diminution sought, subtract the logarithm of a given temperature ($t$) and MULTIPLY three halves of the remainder by the logarithm of the known diminution ($d$) of strength at the latter temperature, and the PRODUCT is the logarithm of the required diminution at the temperature assigned."

Had the formula stood alone, I should, in my innocence, have quietly put the sign + before log. $d$, according to the usual "and time-honoured" practice, and that ancient rule that

$$\log.\ \frac{a}{b}=\log.\ a-\log.\ b.$$

It seems, however, by the accompanying translation of the algebraic formula into plain English ("*in usum tyronum*" I suppose,) that Mr. Scott Russell is determined, that the printer shall not have the chance of being considered as the author of this discovery, (Anglice, "misprint".) It would have been kind in Mr. Russell to have added a note, showing the falsity of the usual rule: as I have not been fortunate enough to discover the error myself, perhaps some of your readers will charitably come forward and show "cause why" the process should not, according to the old plan, be as follows:—

$$\left(\frac{t'}{t}\right)^3=\left(\frac{d'}{d}\right)^2 \therefore\ \frac{d'}{d}=\left(\frac{t'}{t}\right)^{\frac{3}{2}}.$$

$$\text{Log.}\ \frac{d'}{d}=\log.\ \left(\frac{t'}{t}\right)^{\frac{3}{2}}=\tfrac{3}{2}\log.\ \frac{t}{t};$$

$$\therefore \log.\ d'-\log.\ d=\tfrac{3}{2}\ (\log.\ t'-\log.\ t);$$

$$\therefore \log.\ d'=\tfrac{3}{2}(\log.\ t'-\log.\ t)+\log.\ d.$$

Mr. Scott Russell is well known for his scientific researches, but as this appears to me by far his most ingenious discovery, it ought to be as widely known as possible, in order that no future logarithm-opolist may bear off the palm, or chuckle over an ill-gotten patent.

Yours respectfully,

"ERECTIS AURIBUS."

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### EXPERIMENTS UPON THE GYMNOTUS ELECTRICUS. BY MM. D. DE MIRANDA AND G. M. PACI. COMMUNICATED TO THE "SCIENTIFIC CONGRESS OF NAPLES," SEPTEMBER, 1845. FROM "ARCHIVES DE L'ELECTRICITE." VOL. V. P. 496, NO. XX., JANUARY, 1846, AS TRANSLATED IN MR. WALKER'S "ELECTRICAL MAGAZINE" FOR APRIL.—CONCLUDED FROM PAGE 272.

We have frequently received shocks when touching the animal with a small metal rod. I have, however, met with some individuals who did not feel it when they held the rod by one extremity, and even irritated the animal with the other. We made the same observations by insulating the fish. These facts confirm the opinion that the latter is warned by an intimate sense of the possibility or impossibility of the electric circulation; when it feels that it is impossible, it does not liberate its discharge, however provoked it may otherwise be; or, if he make the attempt, it is reduced to a slight phenomenon of tension. These facts would equally accord with the observation that the discharge is proportionate to the degree of sensibility of the individual who receives it.

Muschenbrœk was the first who furnished a sound argument to prove the electrical nature of these shocks, by showing that there was no discharge when the fish, that could produce them, were touched with non-conducting bodies. Walsh, Ingenhouss, and Fahlberg were the first to obtain the electric spark from the gymnotus, by interrupting the conducting circuit with two small gold leaves placed upon glass, at the distance of a line from each other. But we obtained it in a much more brilliant and decisive manner. The apparatus that we employed was a small bent glass tube, the two branches of which

were equal, and which was filled with mercury in the bent part; we fixed at each extremity a long copper rheophore covered with silk, one of the ends of which descended into each tube as far as within a line of mercury. The opposite extremities of these wires were attached to two of those wooden handles, furnished with sponges, that are particularly employed in the medical experiments, made with Clarke's large magneto-electrical apparatus. On exciting the gymnotus with the sponge upon the back and upon the abdomen, in points corresponding to the electrical organ, and operating in the dark, we perceive the electric light burning on the surface of the mercury, which we gently agitated. When we introduced in this circuit Henry's multiplying helix, the sparks were greater and more brilliant.

When we had interposed in the circuit a helix which had an unmagnetized steel needle in its interior, the needle was magnetized after a few discharges. This fact agrees with what Faraday observed in London, upon the same fish, in 1839; and which Professors Configliacchi, Barlocci, and Linari had previously observed in Italy with the ichthyochemical current of the torpedo. From the experiment made by Schœnbein and Faraday to decompose the iodide of potassium by the electricity of the gymnotus, we endeavoured to place in communication with the abovementioned rheophores Clarke's large apparatus for the decomposition of salts. We not only obtained the decomposition of the iodide of potassium, but that of nitrate of silver and acetate of lead. The two free extremities of the rheophores were terminated by platinum points; the latter were plunged into a porcelain capsule, containing the solution of nitrate of silver; the decomposition of the salt was not long in being brought about.

We in like manner produced with the gymnotus Nobili's uniform tints and Newton's coloured rings, which Linari had obtained by the electric discharge of the torpedo.

Davy and Linari were the first to discover the calorific power of *ichthyo-electric currents*, the former by employing Harris's electrometer, the latter by employing Breguet's thermometer. In the experiments made on the London gymnotus in 1839, Schœnbein attempted to discover the increase of temperature with Snow Harris's thermo-electric apparatus; but this apparatus having got out of order, he could not continue the experiment. However, Faraday thought that he perceived some indication of heat in the currents of the gymnotus; this induced us to renew the experiment with Melloni's thermo-multiplier. We united a very thin silver wire by its two extremities to two conducting wires; the heat produced by the passage of the ichthyoelectric current was not sufficient to make the wire red-hot; but it heated sufficiently for the thermo-electric deviation of the galvanometer to be promptly manifested.

Walsh, and other philosophers after him, were disappointed in their attempts to observe whether the electricity of fishes presented any phenomena of tension. Linari, however, in 1836, obtained, in the gold leaves of the condensing electrometer, evident signs of positive and negative tension, according as the conductor communicated with the back or belly of the torpedo at the moment of contraction. With regard to ourselves, we were not able to obtain with the gymnotus any phenomenon whatever of electric tension, neither with Singer's electroscope, nor with Bohnenberger's, nor yet with Perego's more recent instrument.*

The same is not the case with galvanometric deviations; we verified on the Naples gymnotus, the facts which had been observed on the London one, by Schœnbein and Faraday, and on the torpedo by Blainville, Flourens, Barlocci, Linari, Matteucci, Zantedeschi, and Prudente. We frequently obtained deviations of more than 90°, which could not be measured by the multiplying apparatus. The needle deviated briskly, as if it had received the impulse of a mechanical blow. The action was so intense as to alter the needle of the galvanometer so as to render it unfit for other experiments. The same fact occurred to Linari, to Zantedeschi, and to Prudente, with the current of the torpedo. Better informed than they, we employed with advantage Majocchi's Universal Galvanometer;† we, in like manner, had occasion to verify the phenomenon observed by Zantedeschi, namely, that it is not necessary to put the conductors into contact with the animal, but that it is enough to plunge them into the water, even at the distance of several inches from the gymnotus, to obtain a considerable deviation at the moment of the discharge. The same result is also obtained with a closed circuit, by placing the hands upon the back and the belly of the gymnotus. Is this an effect of the great diffusion of electricity observed by Schilling and then by Walsh upon the gymnotus, and afterwards by Matteucci and Zantedeschi upon the torpedo?

Since 1836, Linari obtained the most distinct phenomena of induction by the assistance of the electric discharge of the torpedo. The apparatus that he employed was nothing

* Vide Mr. Gassiot's Experiments in "Transactions of Electrical Society."

† Vide *Elect. Mag.* vol. i., p. 275.

more than a system of two helices and three concentric galvanometer coils. The interior helix was electro-magnetic; the exterior was simply a spiral. The extremities of all the wires, of which the helices and the galvanometers were formed, were metallically united on the two sides of the helices and coils. They thus formed the extremities of a single wire in a helix, the thickness of which was equal to the sum of all the wires. Linari obtained galvanometric deviations, magnetization, and the induced spark, by means of this apparatus, which, as we see, was nothing else than a magneto-electro-dynamic spiral, or a large solenoid. A similar arrangement with the gymnotus gave us the same results, namely, an indication of the galvanometer, and feeble magnetization of the needles. Had we excited the animal to a greater extent, we might, in like manner, have obtained the spark. When we placed the back and the abdomen of the gymnotus in communication with Callan's electro-magnetic machine, we immediately obtained a very sensible shock by the induced current.

We verified, by galvanometric deviations and by chemical actions, a law discovered by Breschet and Becquérel, and confirmed by Matteucci, but which is opposed to the opinions of Davy and Walsh, namely, that all the points of the dorsal part of the organ are positive in respect to those of the abdominal part.* We also verified the fact pointed out in London by Faraday and Schœnbein, that the head or anterior part is positive in respect to the tail or posterior part. Finally, we established on the gymnotus Prudente's observation on the torpedo, that the electric currents are transmitted in the direction of the muscular fibres. This observation confirms that of Prevost, that the electro-physiological current in the muscles is from above downward, namely, from the head to the extremities.

Such are the facts that we have hitherto been enabled to verify upon the extraordinary animal that has been transported for the first time into our climate. We hope that we shall not rest here in our researches. Will it be granted to us to observe any new facts, and to contribute to the discovery of any new law, which may reveal the causes of ichthyo-electricity?

## LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65.

| Date of Registration. | No. in the Register. | Proprietors' Names. | Address. | Subject of Design. |
|---|---|---|---|---|
| Mar. 26 | 683 | E. Wakeling and Son. | Gerard-street, Soho | Ventilating Bed-top. |
| 28 | 684 | Alfred Dunn | 14, Chandos-street, Strand | Portfolio. |
| 30 | 685 | John Coope Haddan | Upper Woburn-place, Russell-square, London | Underframing for railway carriages. |
| ,, | 686 | Robert Tibbins | Birmingham | Design for close casing for the handles of telescope hearth-brushes, and toasting forks. |
| 31 | 687 | James Dixon and Son, | Cornish-place, Sheffield | Handle. |
| April 3 | 688 | George Betjeman | 6, Upper Ashby-street, Clerkenwell, London | Improved design for dressing-cases and dressing-tables, &c. |
| 4 | 689 | Gabriel Davis | Boar-lane, Leeds, Yorkshire. | Folding level-staff. |
| 6 | 690 | Louis Nathan | 31, Great Prescott-street, Goodman's-fields, London | Alarum for time-pieces. |
| ,, | 691 | J. Walters and Co. | 82, London-wall, in the city of London | Embossing press. |
| 8 | 693 | Wm. Sadler Kennedy, | Burslem, Staffordshire Potteries, porcelain manufacturer | Improvements in the mode of mounting knobs and roses. |
| 11 | 694 | Julius Hall | Bath | Velocipede guide wheel. |
| ,, | 695 | David Hesse | 8, Back Piccadilly, Manchester. | Imperial shirt. |
| ,, | 696 | Alfred Mortimer Job, and Benjamin Whitfield Nott | 35, Bread-street, Cheapside | Stop-valve oilcan. |
| ,, | 697 | Shoolbred, Loveridge, and Shoolbred | Wolverhampton, japanners | Sponging bath. |
| 15 | 698 | A. Grant and Brother. | Clement's-court, Wood-street | The Demi-shirt. |
| ,, | 699 | Thomas Key | 20, Charing-cross, military musical instrument maker | Six valve French horn. |
| 16 | 700 | Thomas Key | 20, Charing-cross, military musical instrument maker | Four valve cornet à piston, (or cornupean,) trumpet, trombone, and ophicleide. |
| 17 | 701 | Miller and Son | 179, Piccadilly | Railway signal lamp. |
| ,, | 702 | Fenton and Marsden. | Sheffield, Yorkshire | Brace head. |
| ,, | 703 | Thomas Hemingsley. | Willenhall, Staffordshire | Machine for cutting washers. |
| 20 | 704 | James Dixon and Son. | Cornish-place, Sheffield | Percussion-cap primer. |
| 22 | 705 | Richard Clark | 447, Strand, London, lamp manufacturer | The diamond Carcel lamp. |

* With the assistance of Prof. Prudente for the physiological part.

## LIST OF ENGLISH PATENTS GRANTED BETWEEN MARCH 31, AND APRIL 25.

William Henry Moggridge, of 13, Old Burlington-street, Middlesex, dentist, for certain improvements in the plates or pieces for the roofs and gums of the mouth, for attaching thereto artificial teeth. March 31; six months.

John Ainslie, of Alperton, Middlesex, brick and tile manufacturer, for certain improvements in the arrangements for the manufacture of bricks, tiles, and other similar articles from clay and other plastic substances, and in the machinery or apparatus for the manufacture of bricks. March 31; six months.

William Spiby, of Carrington, Nottingham, engineer, for improvements in the construction of furnaces used for heating water and other fluids. April 1; six months.

Harold Potter, of Darwen, Lancaster, paper manufacturer and stainer, for improvements in printing or staining paper. April 1; six months.

Henry Crosley, of King William-street, London, engineer, for certain improvements in the manufacture of sugar, and in the machinery and apparatus employed therein. April 3; six months.

Ferdinand Charles Warlich, of Deptford, Kent, gentleman, for improvements in the manufacture of fuel. April 7; six months.

William Thomson, of Kilmarnock, North Britain, manufacturer and fur merchant, for improvements in machinery for operating upon wool and other fibrous material, intended to be wrought into felted fabrics. April 7; six months.

George Lewis, of High Cross-street, Leicester, locksmith, for improvements in the construction of shutters and blinds for windows and doors, and in the construction of doors. April 7; six months.

James Allingham, of Dublin, gent. and James William McGaulay, clerk, of Dublin, aforesaid, for certain improvements in steam engines. April 7; six months.

Joseph Hunt, of Brixton, Surrey, chemist, for improvements in the manufacture of soda. April 9; six months.

Joseph Bunnett, of Deptford, engineer, for certain improvements in water-closets, part of which improvements is applicable to other useful purposes. April 15; six months.

Peter Armand Lecomte de Fontainemoreau, of New Broad-street, London, for an improved mode of constructing certain parts of the harness of horses and other beasts of burden. (Being a communication.) April 15; six months.

Simeon Hyde, of the Strand, merchant, for improvements in refrigerators. April 15; six months.

William Tutin Haycraft, of Greenwich, doctor of medicine, for improvements in steam engines. April 15; six months.

Charles May, of Ipswich, Suffolk, civil engineer, for improvements in machinery for punching, riveting, and shearing metal plates. April 15; six months.

Henry Mandeville Meade, of New York, America, gent., for improvements in preparing food for animals when Indian corn is used. (Being a communication.) April 15; six months.

Elijah Galloway, of Buckingham-street, Strand, engineer, for improvements in locomotive engines. April 18; six months.

Joseph Clinton Robertson, of Fleet-street, civil engineer, for certain improvements in the manufacture of pins. (Being a communication.) April 18; six months.

John Gillett, of Brailes, of the firm of Ward, Colbourne, and Gillett, of Stratford on Avon, and Brailes, near Shipston on Stour, Warwick, agricultural implement makers, for an improved machine or machines, for cutting, slicing, and otherwise dividing hay, straw, turnips, and other vegetable substances. April 18; six months.

Peter Bishop, of Birmingham, manufacturer, for a certain improvement, or improvements, in the manufacture of bayonets. April 21; six months.

William Heward Bell, of Edmondsley, near Chester-le-Street, Durham, for improvements in working coal in coal mines. April 21; six months.

Arthur Philip Perceval, of East Horsley, Surrey, clerk, for improvements in communicating between places separated by water. April 23; six months.

William Ashby, of Croydon, Surrey, millwright, for certain improvements in the manufacture of flour. April 25; six months.

George Philcox, of High-street, Southwark, watchmaker, for improvements in the construction of chronometers and other time-keepers. April 25; six months.

## LIST OF PATENTS GRANTED FOR SCOTLAND FROM THE 22ND OF MARCH, TO THE 9TH OF APRIL, 1846.

Julius Adolph Detmold, of London, merchant, for improvements in the means of applying steam as a motive power. (Being a communication.) Sealed, March 23.

Alexander Bain, of Hanover-street, Edinburgh, engineer, for improvements in electric clocks and telegraphs, parts of which improvements are applicable to other purposes. March 25.

James Ivers, of Preston, Lancaster, machine maker, for certain improvements in machinery or apparatus, for preparing, roving, and slubbing cotton wool, and other fibrous substances. March 30.

James Stokoe, of Newton, Northumberland, millwright, for improvements in purifying the vapour arising from smelting and other furnaces, and in recovering therefrom the useful matters which may be intermixed therewith. April 2.

William Mather and Colin Mather, of Salford, Lancaster, engineers, for certain improvements in boring earth, stone, and subterraneous matters, and in the machinery, tools, or apparatus, applicable to the same. April 2.

Charles Cowan, paper manufacturer, in Valleyfield, near Penicuik, Edinburgh, for improvements in the manufacture of paper, millboard, and other similar substances, which is partly his own invention, and partly the invention of a foreigner. April 3.

George Daniel Bishopp, of Paddington, Middlesex, civil engineer, for improvements in certain engines, or machines, used for obtaining mechanical power, and for raising and impelling fluids. April 6.

Henry Smith, of Liverpool, engineer, for improvements in the manufacture of wheels for railways, and in springs for railway and other carriages, and in axle-guards for railway carriages. April 6.

William Unsworth, of Derby, silk manufacturer, for certain improvements in looms for weaving. April 7.

Pierre Armand Lecomte Fontainemoreau, of Skinner's-place, Size-lane, London, for certain improvements in apparatus for raising and supporting vessels, and other floating or sunken bodies, and its application for the better preservation of life and property. (Being a communication from abroad.) April 9.

Henry Mandeville Meade, of New York, America, gent., for improvements in the manufacture of bread. (Being a communication from abroad.) April 9.

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*Oscillating Engines.*—A pair of engines erected on board a frigate just built for the Spanish government, were tried in the East India Dock on Monday last, which are, we believe, the very largest oscillating engines that have ever yet been in motion. They are of not less than 350 horse-power. The manufacturers are Messrs. Miller, Ravenhill, and Co.

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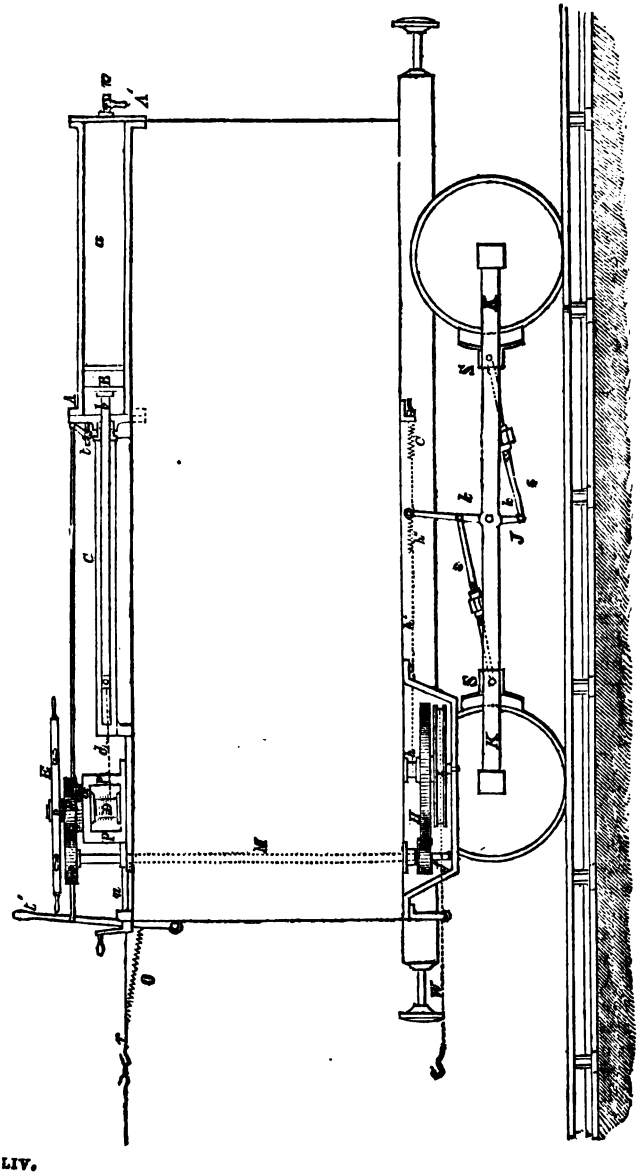
# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1187.] SATURDAY, MAY 9, 1846. [Price 3*d*.

Edited by J. C. Robertson, No. 166, Fleet-street.


## CRAWFORD'S PATENT BREAK FOR ARRESTING THE PROGRESS OF RAILWAY CARRIAGES AND TRAINS.



## CRAWFORD'S PATENT ATMOSPHERIC BREAK FOR ARRESTING THE PROGRESS OF RAILWAY CARRIAGES AND TRAINS.

[Patent dated October 31, 1845. Specification Enrolled May 1, 1846.]

The railway breaks in common use are all more or less open to two serious objections: 1st, that they exert but one uniform amount of power, however various may be the circumstances under which their intervention is required—as difference of weight, or velocity, rising or falling gradients, &c.; and, 2nd, that the promptitude without abruptness, which it is important to observe in applying them, is dependent on the judgment and decision of the persons placed in charge of them—qualities not often possessed in a high degree by individuals of the class from which railway guards are ordinarily selected, and which, even in the same individual, do not exist at all times in the same degree.

In the apparatus which we have now to bring under the notice of our readers, atmospheric air is made use of—not as in some other plans which have been proposed, to furnish the resisting or retarding force, but—to give motion to a small engine, (mounted on the top of the railway carriage,) which works the breaks with any degree of speed or force which circumstances may require. Once started—which is done by the mere pulling of a cord, or turning of a handle, and may be done as well by the engine driver as the guard—the apparatus is in a great measure self-actuating, and self-controlling. The retarding force applied may be encreased or diminished at pleasure, whatever may be the number or whatever the weight of the carriages in the railway train.

In the prefixed engraving, A A′, is a cylinder which may be either firmly fixed on the top of the carriage, or allowed to oscillate slightly by means of gudgeons at the point, *a*. B is an air-tight piston, and *b*, its rod, which works through a stuffing-box in the end, A, of the cylinder, its outer end being guided by slides working in the guides, C, on the roof of the carriage. The air contained in the cylinder between the piston or the cover at A, serves the office of a spring to the piston. Air is admitted above the piston through the cock *t*, which is opened or shut at pleasure by means of a rod, R, attached at one end to the cock, and at the other to a lever or handle *t′*; *w* is another cock at the bottom of the cylinder for the admission or exclusion of air as required; *r* is a cord attached to the handle, *t′*, and carried along the carriages of the train, and terminating at the engine or tender, where it is under the control of the engine-driver. The cord *r*, is prevented from shaking the lever or accidentally opening the valve *t*, by attaching a spring *o*, at one end to the cord, and to the carriage at the other end. The cord, *r*, in its course over the tops of the carriage is protected by means of a hinged tube. D is a barrel supported in a sliding frame, *p p*, round which is coiled a chain, or rope, *d*, the other end of which is attached to the end of the piston-rod, *b*. Upon the axis of the barrel, D, is fixed a hand-wheel E, spur-wheel F, and a ratchet-wheel G. The wheel F, takes into a wheel *e*, upon the vertical shaft M, upon the lower end of which is keyed a pinion, *f*, which takes into the wheel H, under the floor of the carriage. The wheel, F, may be thrown out of gear with the wheel *e*, by forcing the sliding frame back by means of the screw *n*. The wheel, H, carries on its axis a barrel *h*, round which is wound a cord or chain, *h′*, which communicates through the intervention of a spring, *h″*, with the breaks hereafter described; upon the axis of the wheel, H, is also fixed a pulley, I, communicating by a chain or rope, W, with a corresponding rope on a similar pulley in the next carriage. If necessary, a counter-rope may be used to connect the opposite sides of the pulleys. S and S′ are the breaks which slide upon the bar, K, (connecting the axle boxes;) they are acted upon by the rods, *s s*, which are moved by the double lever, *k k*, on a shaft, J, running under the carriage and turning in bearings in the bar, K, and a corresponding bar on the opposite side of the carriage, to which a second set of breaks may, if thought advisable, be adapted and worked in a similar manner. L is a lever on the centre part of the shaft, J, to which is attached the spring *h″*, before referred to, and also a spring, *c*, for the purpose of withdrawing the breaks from the wheels of the carriage, when released therefrom. A counter weight, carried from the lever, L, may be used

in lieu of the spring, *c*. The rods, *s s*, are adjusted for length by right and left screwed couplings at their centres. The springs may be of a helical form, and made capable of adjustment by any of the means commonly used for such purposes.

The action of the apparatus is as follows:—Supposing the piston B to be at the part A′ of the cylinder, the cock *w* is closed and *t* opened. The piston is then drawn to the end, A, of the cylinder by turning the barrel D, by means of the hand wheel, E; and the wheels *e* and F being in gear, the motion of the wheel F causes the pinion *f* to turn the wheel H, thereby unwinding the chain *w* off the pulley, I, whilst the action of the counter-ropes, before described, or of a spring similar to *h″* in the next carriage, causes the pulley of that carriage to wind up the rope. The cock *t* is now shut, and the machine is ready for operation: for upon opening the cock *t*, by pulling the rope *r*, or the handle *t′*, the action of the air forces the piston to the other end of the cylinder; and the chain *d* acting upon the barrel D, and the gearing before described, the chain, *h′*, is wound upon the barrel *h*, thereby forcing the breaks upon the wheels. At the same time the chain, *w*, winding upon the pulley, I, causes the pulley in the other carriage to revolve, and acts upon the breaks in that carriage in a similar manner. The like system of action may be extended to any number of carriages, through chains, or ropes and pulleys, similar to those already described.

The object of disengaging the wheels, *e* and F, is to enable the springs, *h″*, to react upon the pulley, I, and in a similar manner upon those of the other carriages, and thereby to remove the breaks from the wheels.

The inventor proposes to apply the cylinder and machinery for winding up the piston, to the break carriage only of a train; but the breaks of each carriage may be worked independently of it by means of a handle applied to the upper end of the rod, M, in place of the wheel, *e*. Instead also of the cylinder, AA′, a spiral or other spring may be used. The piston might also be actuated by means of compressed air, but the arrangement for that purpose would necessarily be more complex, and Mr. Crawford does not therefore recommend that it should be so employed.

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## MISCELLANEA MATHEMATICA.—NO. XI.

(Continued from page 284.)

### *Geometry studied as a rational science.*

We shall now presume that the reader is prepared to enter upon a course of *geometrical investigation*, in the strict sense of the term; and though possibly in some respects, other works (on the same *model*, however,) besides that of Euclid might be with advantage consulted, yet we know of no one, not even that of Legendre, which, taken as a whole, would be so safe a guide to him.

There can be no doubt that some degree of familiarity with the terms, and with the visual appearances of the figures of geometry, which every one whom we now address possesses, will place our student in a more advantageous position for the commencement of a course of rational geometry, than if he were entirely ignorant of them. In fact, in ordinary courses of general instruction, the greatest difficulty of which we have heard teachers of mathematics complain, is, the inadequate knowledge of the ordinary terms of geometry, which is furnished from the preliminary books in use for children—nay, in most cases the *erroneous* notions which such books convey to the young mind. Considerable time is thus lost in acquiring correct notions of the very objects with which geometry is conversant, in all general schools; as these are only collected by repeated efforts of the mind, and after considerable recapitulation on the part of the teacher. All this inconvenience is escaped by the preliminary mechanical practice in geometrical construction, and by the suggestions which that practice inevitably forces upon the mind. Neither architecture nor engineering are professions selected by young men of inferior capacity,—we abate, of course, the railway mania of the past year. On the

contrary, they are selected rather for the taste and talent which they are calculated to open an opportunity for cultivating with distinguished success. We assume, and we consider that we assume it on good grounds, that the profession is stocked with students whose talents considerably exceed the average amount of that which exists in the middle classes of society. We have made our appeal to them; and we feel convinced that they will pay that deference to the long experience and observation which has dictated our present series of notes, so far as to give our proposed course of study a fair trial. All we ask of them is, that they shall hold in abeyance for a few short weeks of study those notions which their reflections upon the mere mechanical practice of geometrical construction, as regards *proof*, has tended to produce. We feel an entire confidence that, if this condition be complied with, that abeyance will terminate in something akin to self-reproach for the absurd imaginations of former days.

The student's first business must be to acquire a clear view of the conditions which essentially constitute a *perfect argument*, or in technical language, the *categorical syllogism*. We are happy in being able to avoid entering into any details concerning the formal logic, by referring the student at once to Professor De Morgan's tract, entitled, "First Notions of Logic;" in which the fundamental principles of the "Art of reasoning," are laid down with much clearness and precision, and with direct reference to the use of logic in the exact sciences.

The general object of geometrical reasoning is to compare two magnitudes, or two ratios, with each other, by means of some third magnitude of the same species, to which each of them has a known, a given, or a determinable relation. The comparison is simply as to equality or inequality, double or half, &c. The general term *agreement* in formal logic is, in its mathematical application, reduced simply to *equality*, and *disagreement* to *inequality*; and nearly all the quibbles of the scholastic ages, which tended to bring the Aristotelian logic into contempt, have turned upon the substitution of verbal agreement for agreement in fact and essence. Under the simple forms of geometrical reasoning these quibbles found no place; and we would strenuously urge that the student should no further "dabble in the mysteries of the Oxford Logic," than as it *strictly* applies in geometry.

We quote, however, one brief passage from Pott's Euclid, pp. 46-7—a work to which we have already referred in a review a few weeks ago.

(*a.*) "Every *syllogism* consists of three propositions, of which two are called the *premises*, and the third the *conclusion*.

(*b.*) "These propositions [amongst them] contain three terms [each proposition containing two terms,] the *subject*, and *predicate of the conclusion*, and the *middle* term which connects the predicate and conclusion together.

(*c.*) "The subject of the conclusion is called the *minor*, and the predicate of the conclusion is called *the major term*, of the syllogism.

(*d.*) "The major term appears in one premis, and the minor term in the other, with the middle term which is in both premises.

(*e*) "That premis which contains the middle term and major term, is called *the major premis*; and that which contains the middle term and minor term, is called the *minor premis* of the syllogism.

(*f.*) "As an example we may take the first syllogism in the demonstration of *prop.* 1, *book i.*, wherein it will be seen that the middle term is the subject of the major premis and the predicate of the minor.

"*Major Premis.*—Because the straight line AB, is equal to the straight line AC.

"*Minor Premis* — and because the straight line BC, is equal to the straight line AB.

"*Conclusion*—therefore the straight line BC is equal to the straight line AC.

(*g.*) "Here BC is the *subject*, and AC the *predicate* of the CONCLUSION; BC is the *subject*, and AB the *predicate* of the MINOR PREMIS; AB is the *subject*, and AC the *predicate* of the MAJOR PREMIS;

(*h.*) "Also AC is the *major term*, BC the *minor term*, and AB the *middle term*."

We do by no means insist upon the *absolute necessity* of "getting up" even this amount of formal logic, in the terms

which are here employed; yet as a clear conception of the formal and essential reasonings of pure geometry is greatly facilitated by means of it, we urge its adoption as a matter of ultimate advantage, since this will confer *precision* upon those reasonings. To the student who can seize the *spirit* of geometrical investigation this will be unnecessary: and we know that many of our most able self-educated geometers have never taken the trouble to formally analyse and classify the parts of which a demonstration is composed—they perceiving, as it were intuitively, the cases where the syllogism is imperfect or inconclusive. Yet, though some confident boys may "dash out," and swim with a facility approaching to instinctive, the great majority of our species must commence with the "nautilus," "the bladders," or "the corks," or else be doomed to a progress so slow in their aquatic feats, as to disgust or dishearten them with the attempt. So is it in respect of mind.

In all cases, however, it must be kept in view that every geometrical truth is deduced by a comparison between two others, which agree, one in one particular part, and the other in another, with the conclusion so deduced. One of these *may be* (and in one step of every demonstration *must be*) the hypothesis admitted of the existence of the figure spoken of: the other must be some previously ackhowledged, or admitted, or demonstrated truth. From this cause there must be certain *first truths* (one at least) *admitted*, as independent of all formal reasoning. This gives rise to the AXIOMS: which, however, beyond the more "common notions" which constitute Euclid's first seven, and his ninth, have been reduced by the Greek geometers to the smallest possible number. Attempts, indeed, have been often made to repose the superstructure of geometry on *definitions alone;* and to effect this the eighth and tenth of Euclid's axioms have been treated as disguised definitions of *equality* and of the *straight line*—whilst almost as many essays have been made to give a demonstration of the twelfth axiom as to "square the circle" or "double the cube." For men of learned leisure, such amusements may be very suitable; with us, "practical men," they would be preposterous trifling. We have to act as well as to think; and all our thoughts must be given to the most efficient modes of acting. Moreover, whilst all ingenious speculation of this kind has signally failed in either simplifying the principles, or rendering the reasoning more concise, we may safely take the "Elements," though composed more than two thousand years ago, as our guide in geometry, without the slightest fear as to the result.

Another source of difficulty often felt is the definitions of the point, line, and plane, as given by Euclid, and to which we have before alluded. Let us make a passing remark upon this.

The Greeks had no "classic language" from which to borrow their scientific terms. They took the ordinary terms of their language, which generally signified something more than they wished to express, or more than it was convenient to them to mean by those terms. The *forms* of their definitions were therefore, in many cases, *merely restrictive* from the general idea which was attached to the words of the accidental qualities which did not enter into the geometrical conception then under view. This *negative* form of definition, therefore, in respect of familiar terms, greatly prevailed over the *descriptive* form of definition; and we have found ourselves in exactly the same predicament respecting many of the terms which we have *translated* instead of having *adopted as technicals*. For instance, the word γωνία (which has, as its perfect Latin, the word *angulus*,) signifies the *corner of anything*, as of a room, or of a field; but in order *fully* to restrict the term to its geometrical sense, Euclid excludes all other considerations by limiting it to signify the *inclination* of two lines to one another,—or the "opening between them," as it is sometimes familiarly expressed amongst ourselves.

It is just thus with respect to the definitions of space itself. We acquire by the use of our organs of sensation (sight and touch) the conception of magnitude. In magnitudes actually seen or actually felt we really become conversant only with surface. The idea of volume, or space of three dimensions, is, in truth, the result of inference made by ourselves; but so inevitably is this inference made, that our minds are more intensely impressed with this idea of figured space, than with any more abstract one, even than with the ideas from which the inference was itself made. This probably

arises in a great degree from the added suggestions of the sensible qualities of the matter which occupy space; but it is of no importance, on this occasion, to pursue the investigation of such a question further.

It is sufficient for us to remark, that however the idea of space may be gained we have yet the power of abstracting our thoughts from one set of its qualities, and of confining our attention to any other of its qualities. It is thus that we can think of, and reason concerning, length without breadth, and of both without thickness, and of position without either length, breadth, or thickness. We do not in such cases allege that there can actually exist in *a sensible condition* a surface which is not the surface of some body, or a line which is not the boundary of some surface, or a point which is not the extremity of some line; nor do we allege that the surfaces, lines, or points which we exhibit to the senses, *for the purposes of illustration*, are really free from the other qualities of magnitude. We merely restrict our meaning, by those definitions, to be such as we describe; and to the ideas so restricted our reasonings and their conclusions alone apply. Nor, after all, is this peculiar to science; for it perpetually, and almost *as* perpetually, occurs in our ordinary descriptions of things. When we speak of the height of a man, or of a column, we quite as completely leave out of our thoughts the corpulency of the man, or the diameter of the column, as we drop the consideration of the breadth of a line in pure geometry.*

The only subject in relation to first principles yet to be spoken of, is the system of postulates. These, instead of describing the ruler and compasses, and the uses which may be made of them singly and successively, or in combination, merely state, that the special problems soluble by means of them, (or indeed by any means,) which we shall be required to use, are three. These are, to draw a line through two given points; to prolong a given line; and to describe a circle having any given centre and any given radius. The same principle runs through this system as through the system of definitions:—viz., the abstraction of the mind from all considerations beyond that of the particular use to which we may apply those instruments. Euclid also employs the smallest possible number of these postulates; which, in some case, does indeed add slightly to the complexity of a construction and its demonstration. Unfortunately, too, this is felt in the very outset: for the addition which it makes in the second and third propositions is greater than occurs in any future case throughout the entire elements. By this, however, is avoided the use of a fourth axiom, such as—let it be granted, that from a given point in a given straight line, a part may be cut off which is equal to a given straight line. In fact, instead of constructing and proving the construction of the third proposition, assuming it as a thing which can be done. As the student proceeds, however, he will see the systematic advantage that results from the greatest possible reduction in the number of our first principles, whether constructive or demonstrative, much more clearly than any statement of ours could render them at present to his mind.

A few remarks on the "indirect proof," as it is called, or speaking (technically) the *reductio ad absurdam*, appears to us to be necessary; as well as on one or two other collateral topics. We hope to be able to dispose of these points in our next number: after which we shall devote a few pages to the exposition of our views of the classes of geometrical subjects which have the most direct reference to professional utility.

* Take perhaps a still better illustration, which we quote from notes of a lecture delivered at our *alma mater* by the clebrated Playfair, "You have all heard, gentlemen, I dare say, how many miles it is to London; but has it ever occurred to any of you to ask *how broad* they are?"

### SCREW PROPELLING—REPLY TO COMMANDER HOSEASON.

Sir,—I have no doubt the parentally styled *important* letter of Commander Hoseason, R.N., which appeared in your publication of the 25th ult., respecting the merits, or rather *de*merits, according to his notions, of the screw propeller, will receive some notice at the hands of those much better qualified than myself, to deal with the subject; still, I cannot allow such sweeping, and, as I think, most unmerited censure, to be cast upon the inventors and promoters of this useful and splendid improvement in the art of steam navigation, without endeavouring, by simple, although with feeble, means, to remove the erroneous impressions which this letter is likely to create.

I have watched the progress of the screw propeller, from the launching of the *Archimedes* to the present time. I have made many trips in her, some in the *Great Northern*, some in the *Avon* and *Severn*, from Bristol to Newport and back; and one in the *Great Britain*, from Bristol to London. I can therefore speak confidently of *facts* and *results* which have come under my own immediate observation.

I shall not, Mr. Editor, attempt to answer, *seriatim*, the whole of the points of your correspondent's letter, but grapple at once with the main charge, viz., the inefficiency of the screw *in a gale, with the ship head to wind and sea.*

Captain Hoseason will not, I presume, deny that the *Great Britain* in her first trip, from Bristol to London, had a pretty fair trial in this respect; she encountered an unusually heavy gale with the *wind* dead against her *all*, and the *tide* against her *half*, the way from King-road to Lands-end. And what was the result? Did she "*stand still and look at it*," as the *Phœnix* did, according to Captain Hoseason's report? No, Sir. The *Great Britain, the largest vessel in the world*, never made less than 3½ knots by the log, and actually performed the distance from King-road to the Longships, in twenty-four hours or thereabouts. On this occasion, the gallant commander, Lieut. Hosken, stated in my hearing, more than once, that he thought even the *Great Western* (allowed by all to be a first-rate sea-going paddle-wheel vessel) would barely have kept her own under similar circumstances.

In September last, coming from Newport to Bristol, by the SCREW boat the *Avon*, or *Severn*, (I forget which,) with a strong *head-wind* and very *heavy tide*, we beat the *paddle* vessel *three miles* at least in that short journey: but, Sir, it is as notorious as true, that nineteen times out of twenty in *fair*, and invariably in *foul* weather, the same result occurs, although a vessel named the *Swift* was constructed, regardless of expense, in order to drive, if possible, the *screw* boats from off the station.

The slow but steady progress the screw propeller has made, the numerous screw vessels now afloat, and the vast number of others now being laid down upon this principle, speak more forcibly than any argument I can use in refutation of Captain Hoseason's opinions.

In *war* steamers, the advantages of the *propeller* over *paddle-wheels* are numerous and self-evident, and would alone justify its general adoption in the British navy, spite of the *rolling* propensity referred to, which in most cases may be easily remedied, and will not occur at all in sailing vessels, when the *screw* is employed as an *auxiliary* power only.

I certainly am astonished and ashamed of the late performances of the (*idle* not the *busy*) *Bee*, as reported by your correspondent; for she has behaved much better, I know, on former occasions; and I would recommend, therefore, that she be laid up in ordinary forthwith, or else dismissed the service, and her place supplied by some vessel built under the superintendence of Messrs. Stothert and Slaughter of Bristol, the constructors (I believe) of the *Avon* and *Severn*. Such a vessel as they would build would never "*stand still and look at it*," I will venture a wager, nor be reduced to so slow a pace as *one knot* an hour when under any stress of weather, but would be found up to the maximum speed of the best paddle-wheel vessel of equal power on ordinary occasions, and always superior to such, in a gale with *head to wind and sea.*

Captain Hoseason asserts that *his profession, almost to a man*, are unfavourable to the *screw*. I shall only observe in conclusion, that all those gentlemen connected with that profession, whom *I* have had the honour of coming in contact with, (and they are many, some among them men of high rank and great practical experience,)—have *to a man* been unqualified in its praise; I do not therefore apprehend that these distinguished individuals, or their body at large, will be much swayed in their judgment, or forego their former opinions by anything set forth in the *first* or *second* letter of Commander Hoseason on this interesting topic. I am, Sir,

Your obedient servant,

WILLIAM C. EVANS.

Grand Hotel, Covent Garden,
May 6, 1846.

Sir,—Mr. Jopling's habits of vague speculation render him a most impracticable person to reason with. No sooner is one position demolished than he flies off to something else, with the *naïve* remark that—"to general assertions I make no reply." He has for years been throwing out his censures and making his complaints against our profession; and when "Centurion" had shown the untenable character of his pretensions, he passes these by as "general assertions." New verbiage is substituted for the old; and new and magnificent projects are submitted to the lieges to keep Mr. Jopling's *genius* ever before the admiring eye of the public. Let us, however, settle one thing at a time; and first attempt to clear off the new clouds of dust in which Mr. Jopling attempts to envelope the subject.

I will in all cases put the most intelligible construction upon Mr. Jopling's words that I am able, though in some instances, I find it transcends my humble powers to seize his exact meaning. If I make, therefore, any mistake, let it not be called a wilful perversion of its import.

1. In the outset, then, let me remind Mr. Jopling, that a large specimen or a small one is only a question of a large or small instrument for its description; and is, therefore, in no degree an element of the present question. Does Mr. Jopling imagine that his *cranks* are the only instruments that admit of enlargement *ad libitum?*

2. Next; what can Mr. Jopling mean by "clothing the line of stability by a line of beauty"? I do not wish to raise any question upon terms which are used metaphorically—that is a mere question of literary taste: but if the author mean *substituting the line of beauty for the line of stability*, I must tell him that it *will* "affect the stability," to the extent of the change thus made. His quotation of the "four-centred depressed arches" has nothing to do with any remark of mine.

I had, in reference to the quoted opinion of Professor Cockerell, surely expressed myself too plainly to need any further remark from Mr. Jopling: but he carefully leaves out the word *theoretical*, which forms the only difference between us. Was this *accidental?*

3. I enquired for an explanation of the *relevancy* of the reference to Mr. Penrose's measurements: but I am answered by a new suggestion from Mr. Jopling as to a somewhat novel mode of employing the public money. That the Trustees of the British Museum, though wishing to do right, have sometimes been misled, I am willing to grant; yet that they should "devote a gallery" to the purpose of "describing on the floor (of that gallery) with the greatest possible accuracy," Mr. Penrose's hyperbola, and that "a conchoidal line should be drawn by the side of that hyperbola," is a scheme that could have entered into only one single brain, for disposing of the nation's superfluous cash. The fact is, that a piece of shingle (a mere scantling) would answer all the purposes contemplated by Mr. Jopling, as far as a single conchoid and Mr. Penrose's single hyperbola are concerned; and the curves may be constructed with as great accuracy in Mr. Jopling's back-yard, as in "a gallery of the British Museum." But Mr. Jopling forgets (he must know) that the conchoid is not a curve of an unvarying form, or, (as the mathematicians say,) of a single parameter, like the circle, parbola, or tractrix; and hence, that *one* such line would by no means, though traced with "the greatest possible accuracy," answer the purpose of testing the true form of the Parthenon-curves. The *true* mode of testing this question is in some respects more simple, and in others far more difficult, than Mr. Jopling thinks. But I cannot enter upon so wide a subject here; nor do I think any purpose, but that of mystification, can be answered by the quotation of the very vague statements of Revell in the "Antiquities of Athens."

4. I never said that equations could give "the feeling of a curve:" and I should like to be informed in what way the *cranks* can supply their place in this respect. As a term of art, the word *feeling* has a very expressive meaning: but as a term of science, it is the symbol of inaccuracy—of a departure from the truth for the sake of visual effect. When, I would ask, have I made any remark that brings the question of *feeling* under discussion? And where have I denied the use of any instruments that can be

employed for the description of curves? I dare venture to say, that Mr. Jopling is the only one of my readers who has misconstrued what I said upon the subject of the equations of curves— whether ignorantly, or wilfully, I know not, but certainly he has misconstrued me.

I did not say that any mathematician can "sketch and design from equations with accuracy;" nor does it follow from what I did say, as Mr. Jopling tauntingly intimates, "that they should know the equations from seeing the curves correctly drawn." These are fictions, and disingenuous ones, of Mr. Jopling's own creation. He then goes on, "Is it not that the method of describing a line must be first known, and then the mathematician can investigate it?" To be sure it is; and I call upon Mr. Jopling to show that any mathematician has committed such an absurdity as to hold any other opinion. It is most intolerable that such nonsense should be affiliated upon the *mathematician*—that auxiliary to our profession, the most valuable we can ever obtain, and who ought not, in common policy, to be branded as worse than an idiot to gratify Mr. Jopling's antipathies to *accurate science*.

5. To set Mr. Jopling right, I must recapitulate, in a somewhat more extended form, what I did say on the subject of equations.

Every special "regulated motion," (to use Mr. Jopling's own terms,) will trace out some special curve. "What is that curve?" is the first enquiry. By a series of reasonings conducted on the principles of pure geometry it can *sometimes* be shown that the effective result of that motion is identical with some previously known genesis of a known curve; and hence, the curve itself, so traced, becomes known, and another mode of describing that curve is added to our previous stock. Or, again, it may *sometimes* be found, (mind, by *strict geometrical deduction*,) that any arbitrary point in the curve has a defined and invariable relation to some parts of the data of the construction, which are previously known to be properties of a special curve. In this case, too, the curve becomes identified with a known curve, and we are supplied with a new genesis of it. Beyond the conic sections, however, our *geometrical* knowledge, in the sense used above, of the properties of curves, is extremely limited. I believe there is scarcely a property of any one of them which could be deduced by strictly and unaided geometrical reasoning, which is not given in Leslie's "Geometry of Curve Lines," affixed to his "Geometrical Analysis;" and several, even of these, are obtained by means which do not approach to the character of which I am speaking.

I beg of Mr. Jopling to understand that I repudiate his "able geometer— the eye" as an authority in this case; and that I refer to such geometry as that of *Euclid* or *Apollonius*, when I say "strict geometrical deduction." I am at the same time under the necessity of apologizing to your readers and yourself for insisting so directly upon points that few persons in our day would need to see enunciated in so formal a manner.

5. To return. The means of generating curves of common occurrence, and in ordinary use, are already sufficiently numerous, and generally sufficiently simple for practical purposes. At the same time, none of us wish to discourage the invention of methods still more simple in their mechanical structure and mode of operation; but, on the contrary, we should hold them a valuable boon to the draughtsman. As far as I have been able to understand Mr. Jopling's pretensions, I do not find the parabola or hyperbola amongst his results; but if he has been able to construct them, I am open to correction, and shall be glad to be informed under which division of the Septenary System they fall. That the movement of his two poles on two lines describes the ellipse, I admit, and this forms his third division. Does he really mean to tell us that this is *new?* It is a property very familiarly known to geometers; and in fact the *common elliptical trammel* is a specimen of this division of his system. Even in his most generalised form, it is "an old saw."

The great point to be ascertained in the case of every one of Mr. Jopling's arrangements, is the *nature of the curve itself*, which is generated under that arrangement. Mr. Jopling does "not doubt that, *when thoroughly investigated*, there will be a system of equations corresponding to the Septenary System." His notions of the equations of curve lines must be somewhat misty to have led to this remark. I fear some of his readers will think Mr. Jopling to

rather belong to the Hudibras than to the Maclaurin school:—

"Whose notions fitted things so well,
That, which was which he could not tell."

However, let me tell my critic that to every "regulated motion" there *must be* "a corresponding equation." That there is no regulated motion whatever which produces a curve whose equation cannot be found by sure and unfaltering methods; and that the application of these methods is in no other way difficult than that it sometimes becomes laborious—occasionally extremely so. But in these cases, the method of equations is the *only one* by which the curve can be identified as to its family characteristics. In utter ignorance of any criterion, Mr. Jopling insists upon our receiving the evidence of *his own eyes* in proof that any one of his "regulated motions" produces the curve which he pleases to say it is! Now in all cases where a curve has been brought prominently under the notice of mathematicians, its equation is known; and it behoves Mr. Jopling to find the equation of the genesis which *he* assigns for the same curve, and show its identity with the known equation of that curve. Till he does this, or establish by geometrical *reasoning*, the truth of his allegation, he does nothing at all to the purpose. Genesis of curves are daily proposed in the mathematical periodicals, almost innumerably, as mere exercises: but mathematicians never place any value on the genesis, but on the neatness with which the equations of the curve, its length, area, evolute, singular points, &c., are brought out. Hundreds quite as neat and far more applicable to the arts of life may be picked out of our Diaries, Companions, Repositories, Correspondents, Enquirers, and such like works, in a few hours. Let Mr. Jopling try. At any rate let him not shift the question from its true ground. If he attempt it, he must not expect me to follow him further—I must leave him to the enjoyment of his own professional vagaries. We must have his alleged curves *identified*.

6. One of Mr. Jopling's strange fallacies is—that *his processes are those of practical geometry*. He confounds the construction of geometrical problems with the mere mechanism of three bars of wood. He calls himself a "practical mathematician," because he has put together a little mechanism that traces a curve—though for the life of him, he could not prove to us what that curve is. The very quotation with which he heads his last letter, betokens his considering himself a practical geometer, as distinguished from the theoretical; and throughout his writings he enforces the same idea upon us. As far as I am aware, there has not been a single case amongst "practical men" of the adoption of his "regulated motions;" and this solely from their feeling no confidence in the accuracy of his statements respecting his curves, or from their not requiring for any purpose whatever the curves which his instruments do actually trace. No theoretical investigation of them has ever been given; and yet a mathematician of comparatively moderate learning would only require a few days' work to complete the entire cycle of his Septenary System. Why then has this *experimentum crucis* never been made? If once made, and the method thus proved to be of the value that Mr. Jopling represents it, he would no longer find the professional world looking with coolness or contempt upon his invention.

7. Mr. Jopling's magnificent array of "first-rate mathematicians," — "linguists,"—"best designers and draughtsmen,"—"mathematical instrument-makers,"—"best workmen" of all possible kinds — "cones, cylinders, cylindrical rings, and spheres:"—these are, though indicative of the inventor's sublime liberality, but a poor compensation for the one thing needful—demonstration. It is akin to his appropriation of a gallery in the British Museum, both as to utility and to the satisfaction of the mind. I believe, at all events, one thing, that there is little danger of Mr. Jopling turning "a professor of mathematics or of the classics;" although some persons are so simple as to think that Sir Christopher Wren has not given less strength or less beauty to St. Paul's because he had been the Gresham Professor, and moreover lived and died in profound and melancholy ignorance of the virtue of Mr. Jopling's cranks.

8. And now for his problem, reprinted from a former Magazine. I have, however, to *guess* at his meaning; for his enunciation is incomplete, if not absolutely incoherent. Judging by the apparent symmetry of the figure, I suppose the point P to be situated in a line

perpendicular to the middle of AB, as in no other case could a symmetrical curve be produced under the given circumstances. Again, it is by no means certain whether he places the tracing point in the plane with AB or with CD; and as this want of precision in the enunciation creates two separate cases, I shall be glad to be informed to which Mr. Jopling challenges my attention. It is immaterial to me which he selects; but I cannot afford the time for unlimited discussion with him. I have promised him a solution, and he shall have a *complete one* of the case he has fixed upon.

I also desire to know what is the meaning of the triangles on AB and *ab*? as he has not mentioned their purport or bearing; and likewise the signification of the *fourth* sentence of the reprinted letter, p. 312, which appears to me a complete solecism. These conditions complied with, Mr. Jopling shall have all his queries, and any other legitimate ones he may choose to ask me respecting this curve, completely answered.

I think myself entitled, in return, to ask Mr. Jopling for a statement of the *uses* to which *this* curve can be applied. He seems to speak of its principal virtue as that of "resembling the phases of the moon." Now it is scarcely possible that even Mr. Jopling can attach any special value to a *mere resemblance* of the moon's phases, when by means of the common trammel we can give an *accurate delineation* of any one of them. What, then, is his object? If he can show that his "Septenary System" possesses the least utility to the profession, he will find no difficulty in obtaining any aid which may be required for a complete investigation of his curves: whilst, if his purpose be simply for ornamental employments, their *properties* become a superfluous enquiry. In an analytical sense, they are most uninviting subjects of discussion; and if not shown to be strictly "utilitarian," can he expect mathematicians to waste their time or the sole purpose of keeping that interesting combination of letters, "JOPLING," a few years longer before the public?

I am, Sir, &c.,

CENTURION.

Home, April 25, 1846.

## NEUTRAL SERIES.—NOTE ON PROFESSOR YOUNG'S REPLY.

Sir,—On referring to the suggestion which called forth Professor Young's interesting paper at page 287, I find that I did not express very distinctly one part of my object in making it, which was, after marking the difference between the Neutral Series and the two cases that simulate it, to remove a prejudice that might have arisen against the value usually assigned to that series, by pointing out a case analogous to the apparently anomalous one of the equality of the two series;

$$1-1+1-\&c.\ \textit{in inf}:$$

$$\text{and } 1-\left(1-\frac{1}{\infty}\right)+\&c.\ \textit{in inf}:$$

Adhering to the Professor's views, I believe that, in the case marked (2) in my former paper, $S=\frac{1}{2}$, and that in that marked (1) $S=\infty$ if we suppose the series to stop at an infinitely distant odd term, and $-\infty$ if the number of terms be supposed even; but in the absence of these suppositions are we not driven back to the results of p. 267 *et seq.* of Dr. Peacock's Report to the third meeting of the British Association?

These suppositions are made successively by Professor Young (in some important remarks at p. 364 of the last volume of the *Philosophical Magazine*) with respect to the strictly neutral series; but is there any inconsistency in supposing that

$$1-1+\&c.\mp 1\mp\tfrac{1}{2}=\tfrac{1}{2}$$

and that

$$1-1+\&c.,\ \textit{in inf.}=\tfrac{1}{2}?$$

In the first case we see that it is immaterial whether we stop at an odd or an even term; in the second have we any right to make any other supposition than that $1-S=S$, and consequently that $S=\frac{1}{2}$? If in the first case we elect to stop at an even term, that election is accompanied by another material fact—the determination of the sign to be prefixed to the $\frac{1}{2}$ on the left hand side of the equation: in the second, does it not become a mere arbitrary assumption? I beg through you, Sir, to express my thanks to the Professor for his courteous answer, and remain

Yours, &c.,

J. COCKLE.

Devereux-court, May 2, 1846.

### STEAM-BOAT FUNNELS.—TILE-DRAINING. —TEA-POTS.

Sir,—The only fault which can be found in the construction of that noble steam-frigate, the *Terrible*, seems to be her unsightly funnels. I think that an efficient substitute for a funnel in action might be devised of something like the following construction. If a large iron cylinder, reaching from the main flue of the boiler to a small depth below the surface of the water outside, be furnished with a revolving fan, the draught created in this way would, no doubt, be sufficiently strong for the purpose; and as the ordinary funnel might be used when the steamer was not in action, the loss of steam-power would not be considerable. It seems to me also that a spare funnel might be stowed away in a vertical position in the centre of the vessel; this might either be used as a water-tank, or being provided with water-tight ends, be in readiness as an admirable foundation for a raft in case of such being required.

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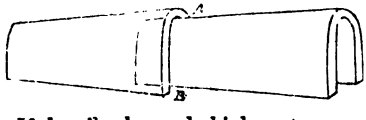
A very simple alteration in the form of the tiles used in draining would, I think, considerably improve their action.




If the tiles be made higher at one end than the other, and the extremity of one placed, say one inch over that of the next, as in the sketch, the earth would be kept out of the space between, while the water might easily run between A B. They would also be less liable to change their places laterally, and each point of the lower edges of the tile being level, there would be an equal pressure on the sole throughout.

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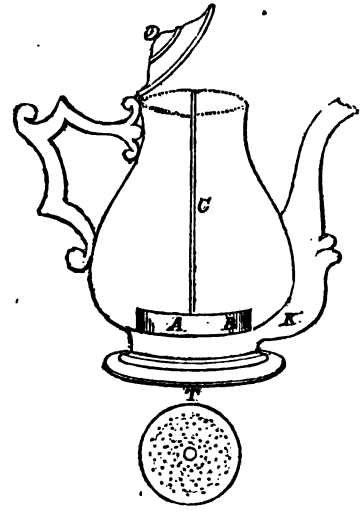
The following addition to a tea-pot, would perhaps encrease its convenience without giving more trouble in the simple operation of "making tea."

Let a circular tray, A B, rest on the bottom ledge of the tea-pot, that is about half an inch from the bottom; and let C be a wire reaching to a convenient height. The tea-pot is to be brought to table in this state; then put in the tea, and place the cover T, with the hole on the wire C, it will fall down to A B. The water may




now be added as usual. The tray, A B, and cover T, must be pierced with a number of holes. The advantages of this method, are these: the tea-pot can be cleaned in a moment by lifting out A B, by the wire C; the water has access to all parts of the tea: the spout can draw the water from K, the lowest point in the pot; and lastly, a new supply of tea can be added immediately by shaking the leaves out of A B, and putting new ones in; thus, the cup, from a second infusion would not be tainted by the vegetable taste which hot-water always produces from tea leaves.

I remain, Sir, your obedient servant,

J. M.

Trinity College, Cambridge,
April 19, 1846.

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### KING'S PATENT ELECTRICAL LIGHT.

Sir,—In your last Number are some remarks appended to the specification of Mr. King's patent for an Electrical Light, where it appears to me you have overlooked the distinctive feature of this arrangement.

All the early attempts that have been made to effect this important and interesting object were founded on the well-known experiment of producing an arch of flame between two charcoal points forming the termination of the conducting wires of a battery; but they have failed, in consequence of the difficulty of rendering the light permanent; for it is

found that the substance of one of the points is carried away and deposited on the other, which ultimately destroys the essential conditions of success, besides which the light frequently ceases without any apparent cause, so that it cannot be depended upon with any degree of certainty even for a few minutes.

Mr. Starr (the inventor of this patented arrangement) has overcome the difficulty by using continuous metallic and carbon conductors, sufficiently thin to be intensely heated by the passage of the electricity through them. This, every electrician will allow, differs essentially from the disruptive discharge taking place through the air, as in the experiment with the charcoal points, which was performed by Sir H. Davy, and of which M. de la Rive's arrangement is only a slight modification.

The experiment of Professor Grove is without doubt the same in principle as that claimed by the patentee, the only difference (when the platinum is used) being in the form of the conductor, which, however, affects the result as regards the quantity of light produced very considerably. The experiment of Professor Grove was first made public on December 1, 1845; but Mr. King's patent was sealed for England,* Nov. 4, of the same year; so that the priority is unquestionable, as is also the novelty of the principle of obtaining light, for useful purposes, from intensely heated continuous conductors. The claim is not for a new substance for producing the electrical light, but for a new method. Carbon has long been used for the terminal points between which the light passes, but its application as a conductor itself to be rendered luminous by the passage of the electricity through it is unquestionably new.

Respecting the utility of the invention, it would at present be premature to offer any remarks, as it must be tried on a scale of magnitude similar to that which will be required for its ultimate application, in order to fairly test it. This will very shortly be done, as Mr. Starr is at present engaged in fitting up apparatus which will fully demonstrate it.

I may, however, observe, that the light produced by the platinum in this arrangement is by no means feeble, for it exceeds in power any light at present used. That from the carbon is still more brilliant than the platinum, and is not in the least degree uncertain; nor is there any reason to believe from the experiments already made, that any change will take place in its substance, however long it may continue in operation. I hope shortly to be able to communicate definitely the results of these experiments, and of others which are about to be made, as they will be found very interesting, not only on account of their useful application, but as affording very beautiful illustrations of the laws of electrical action, and eliciting some new and important facts. Yours respectfully,

WILLIAM WILLIAMS.

1, Francis-street, Regent's-square,
May 1, 1846.

* The patent for Scotland, which was first specified, and is that to which our notice referred, was dated Nov. 26, 1845.—ED. M. M.

## MORE DISCOVERIES IN MECHANICS—MR. JOHN SCOTT RUSSELL (AGAIN) AND MR. WOOLHOUSE.

Sir,—I had the honour of calling the attention of your readers, in your last Number, to one discovery of Mr. Rusself. I have now a somewhat similar task, with your permission, to perform with regard to another. But the present is a much more serious affair, inasmuch as Mr. Russell has set himself up as the rectifier of popular errors on the subject. Moreover, Mr. R. does not here, as in the former case, stand alone in his glory.

The discovery which I now herald in, is a new application of the "Parallelogram of Forces" to the action of the crank.

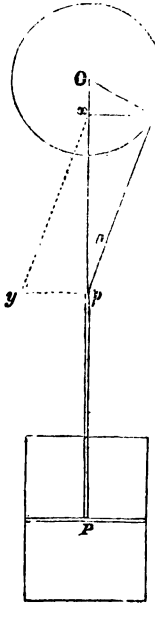
Most of your readers know of the dispute, "Whether power is lost in the crank?" Mr. Russell has devoted a great space in his work on the steam-engine to the question, which he answers in the negative—neglecting friction of course. At page 213 he writes as follows:—

"Suppose the crank OR to be in the position in the diagram, (fig. 178,) where the connecting rod PR is at right angles to it; then the connecting rod PR makes with the piston-rod PP an angle OPR or $\theta$. The force F, therefore, acting along the piston-rod P$p$, being represented by the length of $px$, and $xy$ and $py$ being drawn parallel to $p$R and R$x$, we see that the line

$xy$ or $pR = \frac{F}{cos.\ \theta}$ represents the force in the piston-rod along the crank-rod, tending to make it revolve."

It is plain, from the figure and the statements just quoted, that $Rx$ is perpendicular to OP. Now it is easy to see that this mode of resolving the force F is incorrect.

I can resolve a force in an infinitely number of directions; but if I wish to find the *full effect* of any force in any given direction, it must be resolved into two forces, one *in* the given direction, and the other *perpendicular* to it. Now this Mr. Russell has not done. The *full effect* of F in the direction $pR$ $= F.\ cos.\ \theta$, and *not* $\frac{F}{cos.\theta}$ The latter assertion carries its own absurdity with it. For all your readers are aware that $\frac{1}{cos.\theta}$ or sec. $\theta$ is greater than 1. (Those who are acquainted only with the old systems of trigonometry may be informed that the radius is represented by unity.) Hence $\frac{F}{cos.\theta}$ or F. sec. $\theta$ is *greater than* F; *i. e.* the force in the direction $pR$ is GREATER than the original force F which produces it!!! The error leading to this glaring absurdity consists in resolving F in the direction $pR$, and perpendicular to $pO$. Now the latter force, viz., that in $py$ may be again to two—one *in* $pR$ produced (which therefore diminishes the too great force F. sec. $\theta$) and the other $\perp r$ to $pR$. None but clumsy mathematicians, or those who are writing for beginners, ever dream of constructing the parallelogram of forces in the actual solution of a problem; it is always the custom to write down at once the expressions "F cos. $\theta$" and "F. sin. $\theta$" for the effective force, and $\perp rte$, that line which makes the $\angle\theta$ with the direction of F.




All this is so plain and elementary that I should be ashamed of troubling you with it, did not the existence of such blunders in works of authority show the necessity of exposing it.

There is, however, little cause for wonder at such a blunder in Mr. Russell, especially after his logarithmic achievements, when we find the same slip made by a first-rate mathematician.

It is with reluctance that I am induced to trespass further on your pages; but the subject of the crank is so important that nothing concerning it can be without interest. The mathematician to whom I allude is Mr. Woolhouse, who has written an article on the crank in the Appendix to Tredgold. My respect for this gentleman is so great that it is with much diffidence I venture to offer the following remarks. If this should meet his eye, or that of any mathematician who perceives my error, I shall feel most thankful to him for an elucidation.

Mr. Woolhouse endeavours to establish that no power is gained or lost by the use of the crank! That none is gained I readily admit (although, by the way, Mr. Russell and his sec. $\theta$ prove that there is a *gain!*) but (leaving friction out of consideration of course) what becomes of the *strain* in the crank itself? Is that not power *lost?* It is true that practically it may be of very small amount—in fact the Cornish engines proves this—but that there *is a loss* in this way appears to me so evident, that I could not believe any *theory* which attempted to disprove it. Let us now, then, after this common-sense view,

come to the mathematical one. Mr. Woolhouse uses the principle of virtual velocities for his purpose. Now I have always been taught to consider this principle as a *statical* and not a *dynamical* one. (Your mathematical readers are aware that the *name* is, in a certain sense, deceptive, since the *velocities* considered are infinitessimal and not finite.) The proper principle whereby to estimate the effect of machines in *motion* is that of the "Conservation of *vis viva*,") or rather the equation

$$\Sigma.mv^2 = 2.\Sigma.\ mf\ (\times dx + \gamma dy + Zdz)$$

The principle of virtual velocities may however be applied, provided we consider the system in a state of equilibrium.

Using the same figure as that of Mr. Russell, and calling the force in the piston-rod P (acting in direction PO) and P' the effective force at R (*i. e.* the force which would, if acting in the tangent at R produce the actual motion which takes place ;) if we suppose either of these to act in the opposite direction there will be an equilibrium, and then we may apply the principle. Mr. W., having determined the velocities at R and $p$, proceeds thus:—"But if P denote the moving force acting at $p$, in the direction PO, P', the effective force of R and $c$, the angle OPR (or $\theta$) the force P transferred in the direction of the connecting rod ($p$R) becomes P sec. $c$, &c." Now this is precisely the same mistake as that I have pointed out in Mr. Russell's book. Since P sec. $c$ must be *greater than* P, there would be a *creation* of force if this were correct.

Great men sometimes make great slips, and this appears to me to be the case in the present instance. The *whole* and *only* portion of P which is effective in $p$R = P. *cos.* $\theta$. If we substitute this in place of P *sec.* $\theta$, all the rest of Mr. Woolhouse's investigation will prove useless.

In short, if this theory were correct, it would follow that there is no *strain* in the crank itself—no tendency whatever to loosen the axis from its bearings, which is obviously untrue.

I may just mention, in conclusion, that am well aware of the universal applicability of the principles of virtual velocities; and if properly applied it will of course hold in the present question; but the forces must be rightly estimated, or the whole investigation must necessarily be faulty. Yours respectfully, E. A.

## MR. SNYDER'S IMPROVED METHOD OF TANNING.

Sir,—As you granted me a small space in your valuable Magazine a few weeks since, to expose what I, and by this time, I believe, the public generally, regard as a humbug, I shall be much obliged by a similar favour in the insertion of this article, the object of which is much more pleasing, as it refers to a really useful invention.

I take the greater pleasure in this matter, knowing that the patentee has laboured under great disadvantages, and has only very recently been placed in a position to carry out his valuable improvement.

It is well known that the chief difficulty in tanning arises from the solution acting so much more powerfully on the surface of the skin than its internal substance; that the latter becomes over-tanned, and consequently harsh and brittle before the gelatine of the interior is fully acted upon by the tannin, which protects it from its natural tendency to decomposition. Accordingly, we find that nearly all the thicker varieties of leather are characterized by a stiffness and liability to crack, while the thinner sorts, such as kid, &c., are remarkable for their softness; and thus, in proportion as we gain strength in the material, we lose some of its other most valuable properties. There are some kinds of skin, it is true, which naturally produce a softer leather than the ordinary material of the same thickness; but this again is owing to the looseness and openness of fibre, which, while it admits of more rapid saturation by the tanning solution, renders it, when converted into leather, more liable to strain, and altogether a weaker and less substantial material; so that what is gained in one respect is always lost in another.

Many attempts have been made to overcome this difficulty, such as submitting the skins to hydraulic or other pressure, or forming them into bags, which are filled with the solution and suspended, so that it may be forced through them by its own pressure. These methods have, however, been abandoned; for it is found that this pressure, besides forcing the solution through the skin, also forces out the gelatine combining with it, which is found on the outside of the bags in large masses of slime, and the leather is of a porous, fibrous character, less in weight and more brittle than when tanned by the usual process of simple soaking. This is just the result which might be expected from the loss of the gelatine; for it is by its combination with the tannin forming tannate of gelatine, that the conversion of the skin into leather is effected.

Mr. Snyder's process consists in perforating the whole of the skin with very fine

punctures, varying from one to three hundred to the square inch, according to the thickness or quality of the hide or skin.

It is at once evident that the tanning must now take place much more rapidly, since the solution will enter these fine punctures by capillary attraction, and thus become diffused in all directions; and, accordingly, it is found that by this process less than half the time is consumed than by the ordinary mode.

At first sight a serious objection to this method presents itself, for it would appear that the punctures will render the leather porous, and therefore unfit for many of the uses to which it is most extensively applied. This, however, is by no means the case; and as the action which takes place is rather curious and interesting, I shall enter into some further details respecting it.

It is well known to all who have paid any attention to general anatomy, that the skin of man as well as of the lower animals is composed of two distinct parts; first, the *cuticle* or *epidermis*, which is called by tanners the *grain*; it forms the outer surface of the body, and generally the under or uncoloured side of manufactured leather. This is the portion which is raised by a blister; it is insensible, and constitutes about a fifth or sixth part of the whole thickness of the skin, serving merely as a mechanical coating to protect the under layer, which is called by anatomists the *dermis* or *cutis vera*; by tanners, the flesh. This is a tissue of extremely minute blood-vessels and nerves, performing some of the most important functions in the animal economy; and to the tanner as well as the physiologist is an object of much greater interest than the outer portion of the skin.

It is found, in leather tanned by Mr. Snyder's process, that the perforations are as visible on the cuticle or grain side as they were when first made on the untanned skin; but on the other side—that which forms the face of the leather—they are completely healed, and not at all visible; and that this curious process of healing or closing up of the punctures takes place throughout the whole thickness of the true skin or flesh, is shown by cutting diagonally through it, or by the more severe and decisive test of submitting it to strong pressure by means of the air-pump, when it is found to be decidedly less porous than leather prepared by the ordinary method. The effect of these punctures, which remain in the grain, is beneficial in preventing the "drawing" which takes place in consequence of the astringent properties of the tannin acting more powerfully on the cuticle than on the true skin.

The nature of this healing action which goes on gradually during the tanning, may be easily explained by considering the structure of the skin and its condition when the puncturing takes place. This operation is performed immediately after the bating or cleansing process, when the skin is shrunk to about half its natural thickness. The fine points enter between the fibres without lacerating them, and in the after process while the tannin is combining with the gelatine, during which it swells to about double its former dimensions, these punctures are filled up with the tough substance thus formed—the tannate of gelatine—upon which the essential properties of leather depend.

The result of this process is a most beautifully soft and perfect kind of leather. I have a specimen now before me of about one-eighth of an inch in thickness, which feels more like French kid than the usual rigid material. It is not only more flexible, but it is stronger than leather prepared in the usual manner; for on account of the near approach to putrefaction to which the skin is necessarily reduced in the process of bating or cleansing, there is great liability to partial decomposition taking place in the body of the skin, before the solution can reach it.

This invention altogether affords a striking illustration of the frequently-recurring fact, that a very simple contrivance may often effect objects of great practical value, where more elaborate methods have altogether failed. Yours respectfully,

WILLIAM WILLIAMS.

April 27, 1846.

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*Waste of Water Power in Ireland.*—In Lancashire, every available rivulet is caught hold of. The little current which passes by Bolton and Manchester, Dr. Kane somewhat quaintly styles, "the hardest worked stream probably in the world;" in a fall of 900 feet, not less than 800 are appropriated to the use of mills.—Now, the Shannon (whose total basin amounts to the prodigious area of 4,544 square miles) falls 147 feet from Lough Allen to Limerick, the last fifteen miles from Killaloe presenting a difference of level of not less than 97 feet! The total continuous power above Killaloe calculated from the level of basin is 4,717 horses power, that from Killaloe to Limerick something above 350 horses power for every foot of fall, making for 97 feet the immense force of 33,950 horses power, these added together *giving a force in interrupted action day and night, at every moment of the year, of* 38,667 *horses power!* Yet with the exception of a few corn-mills along the *trajet* of the river, this invaluable force is allowed day after day to go to waste.—*Dublin University Magazine.*

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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1188.] SATURDAY, MAY 16, 1846. [Price 3*d.*

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## BROOMAN'S PATENT PROCESS OF PRINTING AND FIGURING SILK, COTTON, AND OTHER TEXTILE FABRICS.

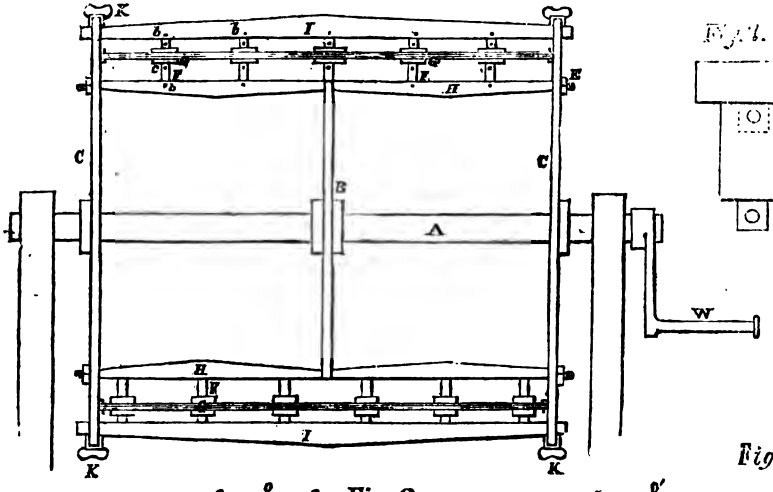



Fig. 1.

Fig. 3.

Fig. 5a

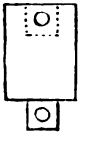


Fig. 2.

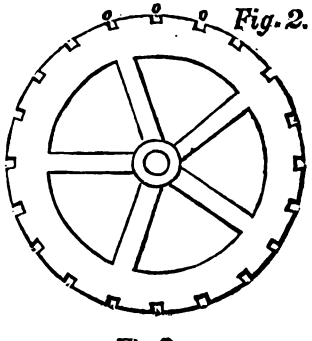
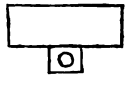


Fig. 6.



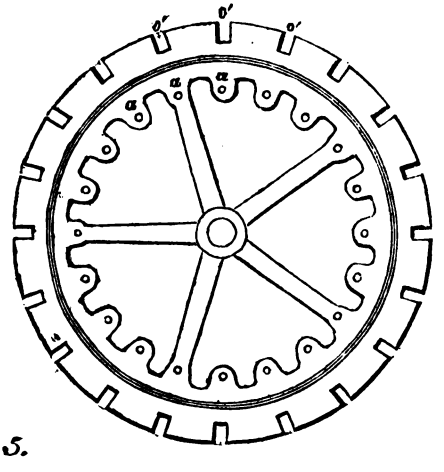


Fig. 5.

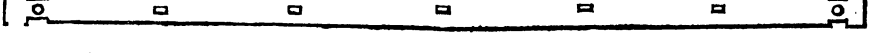
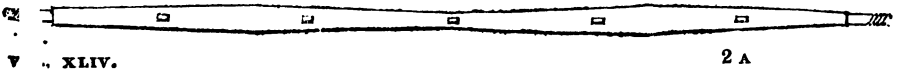


Fig. 4.



## BROOMAN'S PATENT PROCESS OF PRINTING AND FIGURING SILK, COTTON, AND OTHER TEXTILE FABRICS, (A COMMUNICATION FROM ABROAD.)

[Patent dated November 3, 1845; Specification enrolled May 3, 1846.]

THE peculiarity of this new process (imported from Paris) consists in producing the patterns of designs by means of mechanical pressure, or stopping-out, instead of by chemical agents and reagents, or otherwise, as heretofore.

Before proceeding to print any particular fabric, the pattern on which is to be produced by leaving certain parts of it undyed, or dyed of a different colour or shade of colour from the rest, all these parts (called by the inventor reserves) are tightly compressed between blocks or dies, so that on the fabric being immersed in the dyeing vat, the part so compressed shall be protected or in other words *reserved* from the operation of the dyeing liquor. Where many repeats of a pattern are required for one piece of cloth, as many separate blocks or dies are employed as there are repeats; or the cloth is previously lapped or rolled into a number of thicknesses, and each pair or set of blocks or dies, made to act on two, three, or more thicknesses at a time. The blocks, or dies, are mounted in a framework, and the cloth compressed between them according to one or other of several modes described in the patentee's specification.

We select for the purpose of exemplification the first, and perhaps on the whole, the best of the methods described.

Figure 1 is a longitudinal section of a circular framework consisting of an axis, A, an inner ring, B, two outer rings, C C, and a number of cross bars, H and I.

A side view of the ring B is given separately in fig. 2, and a side view of the rings C C in fig. 3, and plans of the bars H and I in figs. 4 and 5. The office of the bars H and I is to carry the blocks or dies. The bars H rest at the centres in the recesses or notches O, in the periphery of the ring B, and are passed at their ends through holes, *a a*, in the rings C C (see fig. 3,) outside of which they are secured by nuts, E E. The bars, I I, rest by their two extremities in the recesses or notches, O′ O′, in the peripheries of the rings C C, and are secured there by screw bolts, K K, the threaded ends of which work into holes tapped in the bottom of the notches. A number of blocks or die-bearers, F F, are let into each of the bars (of both sets,) and secured by pins, *b b*, and each bearer again carries its separate block or die, G, secured in its place by a tennon and pin, *c*. A view of one of these bearers is given on an enlarged scale in fig. 5 *a*, and a similar view of one of the blocks or dies in fig. 6; fig. 7 shows the two united. The blocks or dies of each set are made exactly to face those of the other set. Of the two sets of bars there may be as many as there are notches in the peripheries of the rings B and C, or any lesser number may be employed, and the intervals between them varied as desired. The blocks or dies attached to the bars (by bearers as aforesaid) may be also varied in number, form, and position to suit all imaginable varieties of pattern. The cloth, when about to be printed, is rolled round the inner set of bars H H (the set of bars, I I, being for the moment removed out of the way,) and attached at each turn by the selvages to tenter hooks on the peripheries of the rings C C. The set of outer bars, I I, are now inserted into their places, and screwed hard up by the end screws K K, so as to compress the piece of cloth tightly between the opposite faces of the blocks or dies, G G.

The machine, with the cloth thus wound upon it, is then dropped into the dye vat to about the height of the axis A, which takes into bearings in the sides of the vat, as shown in figure 1, after which it is turned round by the winch-handle, W, for such length of time as may be necessary to give the parts of the cloth left exposed the depth of colour desired.

From what has been stated, it will be readily understood that this stopping-out method of printing need not be limited to one operation, but may be repeated as often as desired, so as to be adapted to printing in any number of different colours. For example, a piece of cloth may by a first operation be dyed in all the unreserved, or unprotected parts of it, of one colour; then by a second operation, some of the parts which were before reserved, may be left exposed and dyed of a different colour; and by a third operation, the remainder of the reserves may be exposed and dyed of a third colour different from the other two. The reserves may also be printed upon if desired.

Sir,—Since last I had the pleasure of writing to you, a singular, conclusive, and edifying accident has happened, the consequences of which will enable me to establish beyond the reach of refutation, the *immense* disadvantage which must arise to my profession by the adopting the screw-propeller in the navy.

When first I mentioned to a friend of rank in the service, an old captain, (known personally to you,) and one well acquainted with many facts connected with the screw, that I intended to expose the mischiefs that must inevitably accrue to the navy from its adoption, he told me I was undertaking no easy task, for I should find myself arrayed against some of the first talent in the kingdom. I smiled, and said I had looked well to my *facts*, and I felt assured that I was in a position to maintain my ground against all comers. Can anything be more conclusive in my favour than this singular truth, that since I wrote my first letter there has not been one single puff in favour of the screw (if I except the one of the *Great Britain* which appeared a few weeks since) to be met with in any paper in the kingdom; whereas, antecedent to my writing, the daily journals teemed with them. When we reflect on the considerable property embarked in the screw, such a circumstance speaks volumes; not a single advocate of sufficient reputation and abilities has courage enough to step out of the ranks and call in question the truthfulness of my assertions; "*a foeman worthy of my steel*" is not to be found.

This *fact*, which arrived too late for insertion in my last, but which I deem the most conclusive that I have yet had the pleasure to disseminate through the instrumentality of your valuable Magazine, is one connected with an accident which lately happened on board her Majesty's beautiful yacht *Fairy*, to *one* of her boilers, (she has but *two*). This boiler burst whilst she was going at the top of her speed,—at the very high velocity of thirteen knots. Now, Sir, the loss of *one* boiler instantly brought her down to *half her steam*, which, as you are fully aware, is *half her power*. According to the law admitted by all, that the horse power required is as the *cubes of the velocities*, we can easily arrive at the *fact* as to what the paddle-wheels would have given out as speed under such circumstances, and a fraction *more* than ten knots would, I contend, have been the speed. But what, Mr. Editor, will you conceive was the velocity of this beautiful vessel, the pride of the Screw-propelling Company under such circumstances? Why, as I am a living man, only *five* knots! Not quite half the speed attainable by the paddle-wheels under similar circumstances! Can anything be more clear and conclusive than this *fact*? Will any person of reputation confute me here, either by denying the *fact*, or by pointing out a marked error in the computation? Has the little *Bee* supplied me with any data more damnatory of the screw as a propeller, *for ocean navigation*, than this *fact*? Let me state to you a few particulars about this yacht. Nobody, I take it, will deny that Messrs. Ditchburn and Mare are able ship-builders, men of sterling talent; and a child can perceive that an engineer of no ordinary abilities made the *Fairy's* engines: the beautiful engines made by Mr. Penn are almost unrivalled, particularly for river navigation. Here, then, we have united in one vessel a fair specimen of the talent of the kingdom; and how is it, then, that with half her power, the *Fairy* could not go faster than *five knots per hour*? Mr. Screw, I file a bill of indictment against you as the true cause, before the public, and I call upon you to confute me if you can.

I will now furnish you, Mr. Editor, with a few particulars about this yacht, which will, I trust, serve to open the eyes of the public. The *Fairy* is a vessel built expressly for speed, is of 260 tons burden, and *one hundred and twenty-eight nominal horses power!!* and with *all* coals on board draws but 5 ft. 10 in. aft., 5 ft. 2 in. forward. Here, then, we perceive a shell of a vessel with nearly the same *nominal* horses power which the *Megæra*, a man-of-war, of 733 tons had when the writer was serving in the Mediterranean; for the *nominal* power of the *Megæra* was but 140 horses. So much for her *nominal* power; let us

now see what the *indicator* will prove her *real* power to be. The *valve* of the *Fairy* is often loaded up to 11 lbs. on the square inch, or nearly so; while that of the *Megæra* I do not believe was more than 4 lbs. So we find a difference in favour of the *Fairy* of 7 lbs. on every square inch of the area of her piston—the very quantity which forms the standard for computing the nominal power when an engine is purchased into the service. Let me make this still clearer to the general reader. When an engine is purchased into the navy, no engineer is allowed to compute the horse power supplied at any higher proportion than 7 lbs. of steam on every square inch of the area of the piston. This, then, is called the nominal or *mercantile* standard; but the *real* powers will of course vary (*cæteris paribus*) as the different loads upon the valve. Consequently, we instantly perceive that the *Fairy* when at *full* power has a vast amount of *real* power more than the man-of-war cited above; and, of course, is consuming steam in the same ratio, always supposing the engines equally well constructed.

This clearly proves that all the important advantages anticipated by me to be derived from the *expansive* action of steam are rendered nugatory in screw steamers; for if you cease to drive your engines at their maximum speed you are a *positive* loser. Any accident happening to your boilers on a foreign station will make a screw steamer frightfully expensive, while at the same time she will be entirely useless in chase of an enemy. Let this be added to the black catalogue of the mischiefs attendant upon the screw, and then your readers will perceive what a position we shall be in, when opposed to a powerful enemy, and having to defend a vast extent of colonial possessions.

When my first letter was written, all that the screw advocates could say, was, that I had not sufficient data to condemn the screw upon. My reply was clear and to the purpose; "if the data be not sufficient for me to condemn it upon, how can the same data and *no other* have justified you in proposing its universal adoption?"

Remember, Mr. Editor, I confine myself distinctly to the *screw* as a *primary*, *not* as an auxiliary power, and as fitted for ocean navigation, particularly the North Atlantic; the field in which, if I read the signs of the times aright, many a bloody battle will sooner or later be fought.

I wish it further to be understood that I oppose the adoption of the screw in war vessels alone. Considering the great demand for increased rapidity, in the carriage of valuable and perishable goods, I think it likely that for such purposes it may be usefully employed, particularly in crowded rivers. Merchants, however, must be content to purchase such advantages as belong to it at a great expenditure of fuel. In England this may be of no great value; but on long voyages, and distant stations, it may be serious. I here give a few instances of this, which will, I trust, serve to convince the most sceptical of your readers.

The price of coal varies at the pit's-mouth, from seven to twelve shillings per ton; in London it is about 24 shillings. When the writer was serving in the Mediterranean during the Syrian war, the price consequent on demurrage, rose to 2*l.* 15*s.* Officers in the West Indies have purchased it occasionally at 3*l.* 15*s.* One paid at Singapore, in the East Indies, *six pounds* per ton for what he bought on account of Government; and I have the authority of the Flag Lieutenant to Vice Admiral Sir William Parker for the fact, that in many of the operations in China, the coal, in consequence of the large sums of money paid for demurrage, did not cost less than *ten pounds per ton!* Let me apply the latter price to the last voyage of the *Great Britain* to New York. She burnt, so it was stated in your Magazine, 1050 tons in 16 days, (and yet fell 200 miles short of her destination;) therefore she would, at the above price, have cost her owners *eleven thousand pounds for coals alone while crossing the Atlantic (!)*

Remember, that when I cite the above high prices, I state it of a period during which freightage was never lower; the whole shipping trade being in a deplorable condition.

War may bring these *enormous* and *ruinous* prices nearer home; for it is notorious, that the *British Queen*, on her last voyage across the *Atlantic*, cost the Belgian Government, for coal pur-

chased at the Western Isles, *five* pounds a ton! And this was one of the causes that put a stop to her running again. I could fill the pages of your Magazine with facts equally conclusive, but the above, I trust, will suffice.

I have the honour to be, Sir,
Your obedient servant,
J. C. HOSEASON,
Commander, R. N.

*Postscript.*

I beg to correct a mistake in my last letter, which I assure all parties I most unintentionally fell into, when I conceived I had the *best* authority for the following statement in paragraph 16th. "The *Rattler* on her last cruise unshipped her screw, to place her under sail alone, as she could not steam off a lee-shore, and the following day was not able to ship her screw again, even in a dead calm." The *Rattler* was *not* placed under sail alone to work off a lee-shore, but worked to windward with the aid of both screw and sails. It was when running up channel on returning to Portsmouth, the wind being *fair*, that the screw was unshipped when nearly off Plymouth; and the following morning, when desirous to connect the screw, to steam through the Needles, they could not do it. I certainly had some misgiving as to the correctness of this paragraph, when I read it over in print, for I could not perceive the object at such *a time* for disconnecting the screw, and I was fully aware, that the *Rattler* was commanded by an excellent seaman; but the reader will perceive that I am right in the only point I was desirous of proving, as will be seen by the context,—namely, that you cannot depend at all times on your ability to connect the screw, in consequence of its position under water. If such things happen in the *Rattler*, which vessel has had so much practice, what may we fairly expect others to be able to do, when the screw has been for some time under water and subject to corrosion?

FEW QUERIES TO COMMANDER HOSEASON.

1st, May not a vessel fail from faults her engines—quite independently of th paddles and screw?

2nd, If a sailing vessel can be built, so that she shall not roll at sea, why cannot a screw vessel be built after the same fashion?

3rd, If a paddle-wheel vessel be made buoyant by her paddle-wheels, how can a vessel go to sea without caps to her outer bearings?

4th, Has our learned Commander ever known a paddle-wheel vessel put about, and run back, because she could no longer make headway; or does he recollect the case of the *President* steam ship?

AN OBSERVER.

DIRECT ACTION ENGINES IN CORNWALL.

Some rather important experiments respecting the steam-engine have been going on in Cornwall during the past year, which were thus referred to by Mr. R. Taylor, at the last annual meeting of the Royal Cornwall Polytechnic Society. We quote from the annual report:—"He alluded principally to the recurrence to the construction proposed by Bull, so long ago as the days of Boulton and Watt. Mr. Sims and Mr. West had erected an engine at Par Consols *working by direct action* without the intervention of a beam; and it would be most curious to watch the results of these engines, and compare them with the result of what is now called the Cornish beam engine. The adventurers of Charlestown mine are also about to erect an engine on Bull's plan."

THE ATMOSPHERIC RAILWAY SYSTEM.

Sir,—You will remember that I communicated to you in private some months ago an idea calculated to answer important purposes in the working of the atmospheric system of propulsion upon railways. I now, with your permission, wish to bring the same before the public, through the medium of your very useful journal. A considerable stress, you are aware, had been laid upon the fact of a systematic variation of power, and consequently of speed, arising from the circumstance of the air pumping apparatus increasing its effective operation, while the distance of the train decreased. A higher degree of velocity was therefore acquired at the latter portion of the trip, between stations, than what was practical at the commencement. Some difficulty was also experienced in stop-

ping the trains at a station, they being liable to overshoot the mark. To obviate these objections I suggested that the stations should be constructed on an elevation above the general level of the line; and that they should be approached in both directions by inclined planes. I have latterly reconsidered the subject, and from observation made while recently visiting the Croydon atmospheric line, as well as from some remarks of Mr. Samuda, to whom I stated my views, I feel convinced of the correctness of the opinion previously expressed. That this mode of applying the undulating principle in conjunction with the atmospheric system would produce *uniformity* of *speed*, appears scarcely to admit of a question; and the only feeling upon the subject is that of surprise that it has not been adopted before now, combining, as it would in this case, both safety and economy.

The advantages of this mode of constructing railways, as respects the stations, are not confined to lines where the atmospheric principle is used, but would be found in some degree realised where locomotives are employed. The inclined planes at the stations would facilitate the stopping as well as the starting of the trains, and would be a means of husbanding the power which the breaksman now annihilates, while gravity would faithfully give back in the form of an auxiliary whatever was due to the elevation. The gradients, as well as the different lengths of the inclines which might be suitable for the different systems, as well as the question whether the inclines should be carried from a point or from an elevated level at the stations, are minor points which require further consideration, and would probably be verified best by experiment.

I am, very respectfully yours,
URIAH CLARKE.

Leicester, May 11, 1846.

METALLIC PISTONS.—THE CASE OF GOODFELLOW *versus* BARKER.

Dear Sir,—If you could make room for the enclosed papers, we conceive it would prove interesting to the readers of your valuable work, inasmuch as many of them may be inventors or patentees, to whom it may be instructive to learn on what a slender thread their ingenuity may depend, and how easy it is to take from them that which may have cost years of anxiety and trouble, attended with no little expense, to bring to perfection; and then, as soon as it is appreciated by the public for its usefulness, to have it taken from them by the ingenuity of lawyers and unmechanical and unscientific jurymen.

The *simple facts* of the case are these: An action—Goodfellow *v.* Barker—was tried at the Court of Exchequer on the 11th of February last, for an infringement of Goodfellow's patent metallic packing. The plaintiff's patent was taken out in the year 1838, and the defendant's in the year 1843. The defendant's piston being considered much superior, began immediately to drive the other out of the market, and thereupon a cry was got up of piracy. The result of the trial, after eight hours' and a half hard fighting, was, that the jury gave a verdict for the plaintiff, damages 40*s*.

The verdict was founded wholely on the fact of there being *three pieces* of metal in each, irrespective of their form or mode of action. The lawyers set up a claim to a principle which was not, and probably was never intended to be, claimed in the specification of the patentee. Certainly, Mr. Goodfellow did not claim the principle of the *two pressures*, nor did he claim every combination of *three spring rings*; but he claimed singly the particular combination of those rings as described in his drawings, &c., including therein, as an essential feature, the bevelled edges brought into action by screwing down the top piece. The great and distinctive feature of the defendant's piston consists in the application of a peculiar formed helical coil or spiral.

That you, Mr. Editor, and your numerous scientific readers may form some judgment of the case, we have sent sketches of the two pistons, together with Mr. Spiller's admirable letter to the judge since the trial: we forward also copies of the two specifications. In conclusion, it may be only fair to observe that, though not ourselves the defendants in the case, we have been the defendant's backers. At the same time, we beg to say that our only object now is to set before your readers the true merits of the case. We are, dear Sir, Yours truly,

PEO. W. & C. MATHER,
C. MILLWARD.

Salford Iron Works, April 4, 1846.

*Goodfellow's Patent.*

Fig. 1.

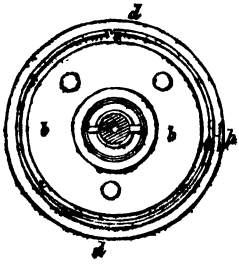


Fig. 6.

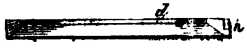


Fig. 5.

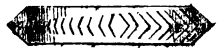


Fig. 7.

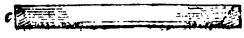


Fig. 4.

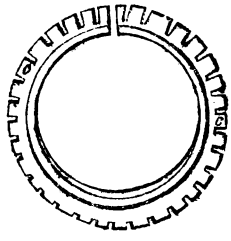


Fig. 2.

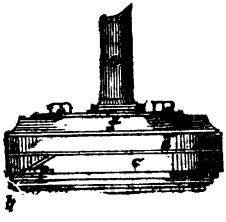


Fig. 3.

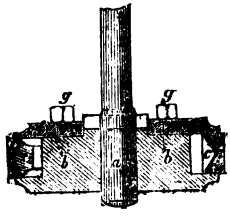
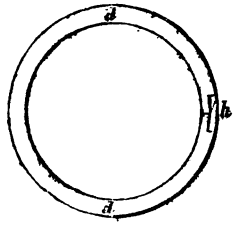


Fig. 8.



*Barker's Patent.*

Fig. 7.

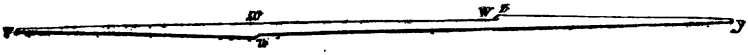


Fig. 2.

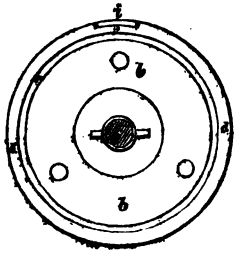


Fig. 3.

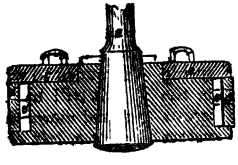


Fig. 6.

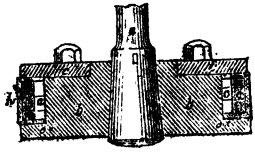


Fig. 1.

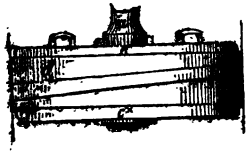


Fig. 4.

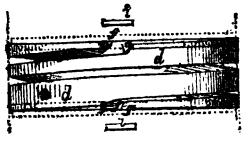
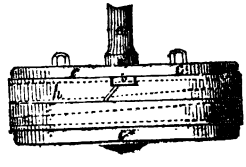


Fig. 5.



*Goodfellow's Specification.*

My improvement in metallic pistons consists in the particular construction and arrangement of certain parts of such apparatus, in order to render them perfectly steam, air, or water-tight, by means of metallic packing, and capable of being used in all situations where such pistons are commonly employed. These improved metallic pistons are composed of a top and bottom plate of metal, in the ordinary manner; between which, are a peculiar combination of annular springs, intended to constitute a perfect steam or air-tight packing, and which are brought into action by means of screws, bearing both in the bed and top plate of the piston, in order to compress the system of springs, and thus, by bringing the top plate close upon the bed of the piston, cause the metallic packing to be brought into perfect contact with the interior of the cylinder in which the piston is employed.

Fig. 1, represents a plan or horizontal view of the piston, with the cover or top plate removed. Fig. 2, a complete side elevation, and fig. 3, a section taken vertically, through the middle of the same. The piston-rod *a a*, has the bottom plate or bed of the piston *b b*, secured to its conical end by a cottar or key, in the usual manner; upon this bottom plate or bed, an annular spring ring, *c c*, is placed loosely, around which are placed two other spring rings, *d d*, and *e e*; the upper ring *d*, being turned upon its interior surface to the same bevel as the upper side of the ring *c*; and the lower ring *e*, being also turned upon its interior surface to a corresponding angle, with the lower side of the spring ring *c*; thus, these two outer annular springs being accurately turned and ground to the plates *b* and *f*, form a perfect metallic packing, being pressed or kept against the interior surface of the cylinder, by the action of the annular spring *c c*. The top plate, *f f*, is fixed upon the bed of the piston by means of the screws *g g g*; and thus, by enclosing the system of annular springs, keeps the whole apparatus together, and forms a perfect steam, air, or water-tight packing. In order to keep the spring packing from being injured by the action of any steam that might otherwise get into the body of the piston, the ends of the springs are furnished with small segmental pieces *h h*, being turned accurately to fit corresponding recesses in the springs *d* and *e*, which will entirely prevent the admission of steam into the packing or body of the piston.

Fig. 4, is a detached plan view of the main annular spring, *c c*, and fig. 5 is a side elevation of the same; in which it will be seen, that it is turned somewhat eccentric, and has a series of openings or mortices cut in its angular periphery, in order to assimilate all points of the spring, and impart an equal action throughout its circumference.

Figs. 6 and 7 are sectional representations of the upper and lower annular springs *d* and *e*, in order to show that their interior circumference is turned to a corresponding bevel with each angle of the spring, *c c*; and fig. 8, is a plan view of the same.

Having now fully described the particular object of my invention, and the manner of carrying the same into practical operation, I desire it to be understood, that I claim as my invention, the peculiar mode of constructing metallic packing for pistons, and also their particular arrangement, as shown in the various figures of the drawing attached to these presents; that is to say, the combination of three perfect annular springs, being compressed and brought into action in the manner and for the purposes above particularly described.

*Barker's Specification.*

Fig. 1, is an external representation of a piston of a steam-engine; fig. 2, is a plan or top view of the same, with the cap or top plate removed; fig. 3, a section taken transversely through the piston; fig. 4, an external view of the metallic packing expanded, or seen as removed from the piston; fig. 5, is an external view; and fig. 6 a sectional view of a similar piston, but slightly modified in its construction. *a a*, is the piston-rod; *b b*, the piston, with its cap or top plate *c c*, and its bottom plate *c* c**; between which the improved metallic packing *d d*, is placed, being, in this mode of application, of a somewhat larger diameter than the piston, in order that there may be some degree of elasticity when contracted and placed within the cylinder in which it is intended to work.

It will be observed in the plan and sectional views that there is a clear open space, *e e e e*, left entirely around the piston, between the body of the piston, *b b*, and the metallic packing, *d d*, and this space allows for any variation or self-adjustment in the metallic packing, as required, and is essential to the application and use of the improved packing. The manner in which the packing is constructed will be more clearly understood by referring to the diagram, fig. 7, which exhibits the outline of the packing, supposing the same to be extended up on a plane; and this figure is shown, that any competent mechanic may understand how the packing is to be produced or turned in the lathe. A perfect ring of cast-iron, or other suitable metal, is to be placed

in the lathe, and after drilling small holes, as starting and stopping places for the cutting tool, a cut is to be made, which shall be taken in an oblique direction, (produced by the ordinary traverse motion of a slide-lathe,) until half way round the ring, when the cutting-tool must stop cutting at the drilled hole in that situation, and a second cut made in a still more oblique direction, and produced by changing the speed of the traverse motion, which will cut or form the line or angle *y z*; the worm or screw is then to be cut parallel, as from *w* to *x*. When this is effected, the ring is to be reversed in the lathe, and the other oblique cuts are to be made, exactly as before, and the reversed angle produced, as from *u* to *v*. It will be observed that the metal to be cut out of the centre part of the ring is three times the width of that removed at the top and bottom, and thus an equal degree of elasticity is left in all parts of the ring of packing. By turning out or removing such portions of metal from the ring, it will be left as the thread of a screw, and, when compressed, it will be found to have attained the desired elasticity. Small pieces are then to be cut from off the extremities, *f f*, leaving a space to allow of the ring being contracted in diameter also. The packing or screwed ring is then to be contracted by clamps, both in its diameter and width, and turned or finished to the intended width of the piston, and the diameter of the cylinder in which it is to be employed: small recesses or channels, *g g*, are to be made in the ends of the packing, to be filled up by moveable stop-pieces, *i i*, in order to prevent the passage of the steam within the packing. In figs. 5 and 6, a piston is represented, with the improved metallic packing, enclosed by rings of brass, *h h*, to be used in those situations where it is preferred.

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*Letter to Sir Frederick Pollock, Knight, Lord Chief Baron of the Exchequer, on the subject of the cause "Goodfellow* v. *Barker," for Infringement of Mr. Goodfellow's Patent for an "Improvement in Metallic Pistons."* By J. Spiller, M.I.C.E., Battersea, London.

Battersea, February 17, 1846.

My Lord,—After mature reflection on the proceedings in the Court of Exchequer, on Wednesday last, in the case of Goodfellow nd Barker, I feel constrained by a love of ustice to offer to your consideration a few emarks in reference to the same. I am ully aware, my lord, that the course I have ow taken is not only an unusual, but, inasnuch as it throws doubt on the efficiency f our national means of obtaining justice on disputed points, an inconvenient one. And I know of no apology to offer your lordship more forcible than the fact, that no human decision is infallible; and my firm conviction of your lordship's constant efforts to administer impartial justice.

I have admitted, my lord, that the course I have entered upon is an unusual one; but it is not without a precedent, as may probably be known to your lordship. I refer to a letter addressed to the Right Honourable Sir James Eyre, Lord Chief Justice of the Common Pleas, by the late Joseph Bramah, in the year 1797, on the subject of the cause Boulton and Watt *v.* Hornblower and Maberly, for an infringement on Mr. Watt's patent for an improvement on the steam engine. In that cause, the late Joseph Bramah had no personal interest at stake; he was subpœnaed as a witness upon that trial; as I was on the trial of Wednesday last, at the request of parties who were perfect strangers to me.

The object I have in view is to lay before your lordship a strictly impartial and correct view of the plaintiff's and defendant's positions; and I venture to hope you will not consider I assume too much, since it is no disparagement to the abilities of any set of men engaged in their special pursuits, that they do not possess that scientific and practical knowledge, which is of such vast consequence in the cause referred to, and to obtain which the most extensive practice is barely sufficient.

With the hope of conveying my ideas to your lordship with more facility, I beg to make the following preliminary remarks.

1st. Theoretically considered, a piston is a mere disc, requiring for its function (if circular in form) a cylindrical cavity, in which to move air-tight. If such a piston and cylinder could be made, and if no wear took place by the working of such parts, what is technically called the "packing" would be unnecessary.

2dly. The cylinder and piston of a steam engine, however perfectly made, by wear become imperfect; not only by the former becoming larger and the latter smaller, but by the cylinder wearing away more in the middle than at the ends, occasioned by the relatively higher velocity of the piston at that part.

3dly. The packing, therefore, of whatever description, must be regarded as a remedy for the defects of construction and wear; and that packing which accommodates itself best to such inevitable defects, so as to preserve a steam-tight contact at the least expense and trouble, must be the best.

As the construction of Goodfellow's and Barker's packing is perfectly known to

your lordship, I deem it unnecessary to attempt any description of either. I therefore proceed at once to show the existence of an essential difference in the action of what the plaintiff, in his specification, calls the main annular spring, (the middle ring of the three,) and the coil used by the defendant; and also, that such essential difference renders the defendant's packing a much more efficient one for the purposes required.

Imagine, my lord, the block of Goodfellow's piston placed without its rings, or top plate, into its cylinder; the rings then put in place, and the plate put on. Let the two outer or packing rings be supposed to fit accurately the cylinder, and the operation of screwing down the top plate to take place.

In this state of things, as the packing rings cannot expand, the act of screwing down the plate must compress the annular spring into a smaller diameter, by the beveled edges of the rings acting on the corresponding bevels, or wedge-like form of its edge; and thus give it a degree of tension, or power, to keep the rings in contact, both laterally and vertically, so as to form a steam-tight packing.

I now beg to direct your lordship's attention to the great skill and extreme care required in the operation of screwing down this plate. As the amount of power that can be embodied in the one annular spring, is barely sufficient to produce the quantity of motion and pressure necessary to compensate both for ordinary imperfections and for the wear of the acting surfaces, for a convenient length of time, the screwing down of this plate for the contraction of the spring should be carried very near to the extent of its elasticity; but, if carried beyond that point, the spring must either be broken, or have its elasticity impaired for re-action. Another nice point to be attained, is the parallelism of the under surface of the plate with the bottom surface on which the rings rest; because any deviation in this respect must, to the same extent, open the joints and make a way of escape for the steam.

If, to obviate the above described difficulties, the parts were so adjusted as to allow of the plate being screwed down to a true and determined surface on the piston, the piston itself would be devoid of the necessary means of re-adjustment, after a little wear of the rubbing surfaces. Hence, space sufficient must be allowed for lowering the plate; and as the workmen performing this operation can have no sensible indication, either of the extent of the compression of the annular spring, or of the parallelism of the planes before mentioned, the effect of the operation, with whatever care performed, must always be uncertain, and, therefore, very unsatisfactory.

I now beg to call your lordship's attention to Barker's packing, in which, it is evident, neither of the above practical difficulties exists. The top plate of Barker's piston is screwed down to a turned flat surface, on the body of the piston at once, and may, therefore, when required to be put in action, be accomplished by the most ordinary workman. Barker, by his coil spring, is enabled to embody, not only a greater amount of elastic power to produce lateral motion, but also power to act vertically, which forces, as far as practice is concerned, act independently of each other.

In screwing down the top plate of Barker's piston, the amount of force embodied for vertical motion, compared with the demand, may be regarded as inexhaustible; and the amount treasured up or embodied for lateral motion, by twisting up the coil, may be as much more than Goodfellow's as the metal or thread of the coil is longer than that of the annular spring. The one annular spring of Goodfellow's has to supply both lateral and vertical pressure and motion, and that through the intervention of a wedge, causing loss of effect by friction. Barker's coil, on the contrary, by direct vertical action on the rings, practically speaking, has no friction, and laterally, less than Goodfellow's; because the expansion of the coil is against a cylindrical part of his rings, in lieu of a wedge-like groove in Goodfellow's.

There is another very important difference in the action or effect of the two packings, to which I now solicit your lordship's *special* attention. Goodfellow, in his specification, says—"In order to keep the spring packing from being injured by the action of the steam that might otherwise get into the body of the piston, the ends of the springs are furnished with small segmental pieces, being turned accurately to fit corresponding recesses in the springs (packing rings,) and which will entirely *prevent the admission of steam into the packing or body of the piston.*"

Your lordship will recollect that some of the witnesses for the plaintiff, Mr. Fothergill and others, concurred in the above, viz., that in the plaintiff's packing, the steam should not, and could not, get into the body of the piston, that is, into the small cavity between the back of the packing and the solid part of the piston. Now I am bound to believe that both the plaintiff and his witnesses were sincere in advocating the above doctrine; and if so, I will

now prove to your lordship that they were ignorant of the action of the piston in both respects.

Imagine the piston placed in the cylinder of a locomotive engine, adjusted, and the ends of the cylinder hermetically closed. Let steam be admitted at one end of the cylinder, suppose at a pressure of 50 lb. on the square inch. What, I now ask, would be the effect of the pressure of the steam upon the packing, if no portion of this steam could get behind it? The rubbing surfaces of the packing rings cannot be kept against the cylinder with a less power than that which tends to separate them, which power is assumed to be 50 lb. upon every square inch. If, therefore, the rings were no more than one inch deep, and the cylinder fourteen inches diameter, the power acting laterally to collapse the rings would be above 4,000 lb.; and to this must be added the vertical pressure for one side, (for the steam is now supposed to be acting on one side of the piston only,) the total power to collapse the packing would therefore be about 5,000 lb.; and as the annular spring made by the plaintiff could not resist one-sixth of this force, and have sufficient action, it follows, as a matter of course, that if the steam could not get behind the packing, such packing must remain in a state of collapse, and consequently be useless. But, fortunately for the plaintiff and those who use his pistons, the steam does get behind his packing, and in this way. When the steam is let on, and at the same instant, the rings collapse, more particularly the rings nearest the pressure, and sufficient steam insinuates itself between the two rings and the space in the annular spring (the ends do not meet,) also between the angular periphery of the spring and bevel parts of the rings, and thus by establishing a pressure as great, or nearly as great, behind the packing, as that in the cylinder, the annular spring is enabled to resume its function—that is, make the piston what is termed steam-tight. Your lordship will easily conceive, that the angular periphery of the annular spring and beveled parts of the rings cannot be steam-tight, because the compression of the ring, after it is notched, would make it assume a figure approaching in a slight degree a polygon of as many sides as it has spaces between the notches; and hence a corresponding number of small openings for steam to enter behind the packing, when the rings are collapsed.

I shall now beg leave to show your lordship the great superiority of Barker's piston over that of Goodfellow's, as it respects the very essential point of admitting steam behind the packing. I have already stated that Barker's coil admits of two motions, and that such motions are practically independent of each other. But there is another very important fact connected with Barker's coil, which is, the great difference of its lateral and vertical forces, the lateral being by far the greater.

In order to show the action of Barker's packing in filling the cavity, let us suppose it placed in a cylinder, in the same way we have supposed Goodfellow's to be placed. If steam be admitted, the packing rings cannot collapse laterally, because the force by which they are pressed against the cylinder is greater, and, independent of that producing the vertical pressure. The weakest resistance must of necessity yield first, and the slightest vertical motion of the ring causes the steam to fill the cavity behind the packing, and the ring at the same instant returns to its place. The introduction of steam behind this packing must, therefore, always be by the vertical motion of one ring, which acts as a valve, the size of the piston, the opposite packing ring acting at the same time as a closed valve.

It is therefore evident that as the packing rings cannot collapse laterally, and the opposite ring to that which admits the steam is, during the operation, close on its ground face, no steam can pass through the piston during the operation of filling the cavity. It is also evident that the cavity must be filled in an inconceivably short space of time, in consequence of the very large space made for its induction by the vertical motion of the ring before described. But in Goodfellow's piston the case is widely different: here it is the same force acting both laterally and vertically; and it requires less force to compress the packing laterally than vertically, because a double action, and consequently a double friction, on the annular spring must result from vertical compression. But the lateral produces only a single action and single friction; and hence, when the steam is let on, the rings must collapse laterally, and thereby cause some waste of steam through the piston while the cavity is filling: and as the passage to the cavity is small, a proportionate amount of time and waste must result from the operation. Should your lordship, after what I have said, have any doubt as to the necessity of introducing the steam behind the packing, I would refer to Tredgold in corroboration of my assertion; and I direct your lordship's attention to that author because all parties at the trial referred to him as an authority.

In the first edition of his work, page 229, article 472, he says:—"It is of importance to

remark, that the metallic packing is *pressed*, so as to be steam tight, *by the steam itself;* and it is *essential to their perfect operation that the steam has egress to the cavities in the piston*, and that the parts fit accurately against each other in all the horizontal joints." And after referring to a diagram to explain his meaning, he concludes the article thus, "*If this were not so, the springs could not possibly press with sufficient force to keep the joints steam tight;* for *a fluid cannot be confined by a force less than its own elastic force*, and hence, the pressure producing friction is always greater than the pressure of the steam on the rubbing surface, by that due to the pressure of the springs." The ignorance of this important fact, on the part of many mechanicians, is hinted at in a note at the bottom of the same page.

I have now, my lord, gone through what I believe will be found a strictly impartial and correct view of the plaintiff's and defendant's pistons, and shown that the essential difference between what the plaintiff calls the main annular spring of his packing, and the coil as made and applied by the defendant, renders the defendant's piston a much more efficient apparatus for the purposes required.

1st. By requiring much less care and skill in its adjustment.

2ndly. By embodying a twofold and greater amount of elastic force for expansion.

3dly. By admitting, in a far more perfect way, and without waste, steam into the cavity between the back of the packing and the body of the piston.

Now, my lord, if what I have written on the foregoing pages is correct, and I challenge any man to disprove it, you will naturally infer I could not help being grieved at the result of the trial, in finding a verdict for the plaintiff. Such a result constrains the mind to reflect on the means employed to decide such questions; and it always has appeared to me repugnant to reason and common sense, to call upon men to decide on a case, of the real merits of which they must, in the nature of things, be ignorant. I say this, my lord, without at all calling in question the respectability, the sincerity, or the intelligence of the gentlemen comprising the jury for this case. But is it not, I would ask, possible, nay probable, that none of the parties had ever seen a metallic piston before they were impanelled to try the case? and are not men placed in such circumstances very much like an individual who is called upon to find his way through a dangerous, difficult, and unknown path, without any, or sufficient light to guide him? Should it be argued that sufficient light was furnished by the evidence adduced upon this case, I would ask, what but a false light was thrown upon it by Mr. Fothergill, who stated more than once, that the annular spring of the plaintiff, and helix or coil of the defendant, were one and the same thing? and, after being beaten out of this absurd position by the learned counsel for the defendant, affirmed it to be the same in its action? What but a false light evolved from the same witness (and I name him because your lordship commented at some length upon his evidence) when he said the construction of the plaintiff's piston was such as *to exclude* (!) the entrance of steam into the cavity behind the packing, which exclusion he considered necessary? I say, my lord, and risk my credit, both in a scientific and practical point of view upon the assertion, that such statements are contrary to facts, and prove to my mind, that in order to a correct decision, the jury ought to be composed of men practically and scientifically conversant with the subject.

In summing up the evidence, I consider your lordship inclined to the idea, either that the defendant had infringed upon the whole of the plaintiff's invention, or upon a part of it, by taking his packing rings, and placing a different spring between them to produce the same effect.

With the greatest deference to your lordship's judgment, I must be permitted to say, the rings of the defendant cannot be said to be the same as the plaintiff's. The section of the plaintiff's would be nearly square, with one of its inner edges turned off at an angle of about 45 degrees. The section of the defendant's represents the letter L, or two parallelograms united at right angles; and neither a lawyer nor an engineer could, by any possibility, make either to replace the other. Both are rings cut so as to form what is called annular springs, and both are intended to act by expanding force, and form a packing; but this is common to all packing rings, hundreds of which were made prior to the date of the plaintiff's patent. And if a fair comparison were instituted, the defendant's rings would be found to differ much more from the plaintiff's than the rings of the latter do from all rings known prior to the date of his claim.

I beg now to conclude this long letter, for which I feel myself bound to apologise to your lordship, by asking one or two important questions, which naturally arise from a review of the whole.

1st. Has the defendant a right to continue making his pistons for his own benefit, and the benefit of the public? The verdict declares he has not.

2ndly. Has the *plaintiff* a right to make pistons in all respects like, and, conse-

quently, possessing all the advantages of the defendant's, without vitiating his claim to his monopoly by so doing? If he has, and thinks proper to do so, how will the patentee's pistons agree with his specification, which, by law, is required fully and completely to describe the nature of the invention, and the manner in which the same is to be performed? And if not permitted to work upon the defendant's plan, without vitiating his claim, does it not follow, as a matter of course, that the verdict is unsound?

3dly. If the plaintiff *has* a right to work upon the defendant's plan, and he refuses to do so, is the public to lose the advantages of the use of the defendant's piston, until the expiration of the term of the plaintiff's patent?

I admit, my lord, that the above questions are much easier to propose than answer; at the same time, if a satisfactory reply could be given to them, it would be a matter of no small pleasure to, my lord, your lordship's obedient servant,

J. SPILLER, C. E.

To Sir Frederick Pollock, Knight,
Lord Chief Baron of the Exchequer,
Westminster Hall.

P.S. The impression which appeared to me to be made upon the court, that the plaintiff was the first who had invented a "perfect metallic packing," was a false one. There is no metallic packing in existence that can replace the double cupped leather of an hydraulic press, when acting with full effect, for one minute; and the advantages of the plaintiff's piston over others made before, is not so much a matter of fact as one of opinion. And I believe it will be found that the superiority of Barker's piston over Goodfellow's, is more marked, and better defined, than that of the latter over others made before the date of the plaintiff's patent. The object desired is perfection, and every step towards it is worthy of reward; and, as Barker is a step in advance of Goodfellow, Barker is as much entitled to reward as Goodfellow would be, if he could prove he had made a step in advance of others.

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*Note by the Editor.*

An appeal from the verdict of a jury to the tribunal of public opinion is, as Mr. Spiller states of his letter to the Chief Baron, "unusual," and is only to be justified by such an "unusual" pressure of hardship on one or other of the parties to the suit as the present case displays. We agree with Mr. Spiller in thinking that the verdict was at variance with the actual facts of the case, though (as he seems to admit) not with the manner in which those facts were presented to the jury. Had Mr. Spiller himself been examined, and had he but spoken to the points at issue in the witness-box as ably as he now writes upon them, the result might probably have been different. Mr. Spiller appears to us to convey a reflection on the jurymen impanelled to try the case which was by no means called for, when he observes that "in order to a *correct* decision (in such cases) the jury ought to be composed of men practically and scientifically conversant with the subject," which is as much as to say that the jurymen in Goodfellow *v.* Barker were very much the reverse. We may lay it down as at least equally certain, that to enable any jury, however composed, to decide a case properly, it is necessary they should have the facts of it brought correctly and fully before them. Clients and their counsel are to blame, at times, as well as judges and juries. By what test, may we ask, would Mr. Spiller determine that the jurymen in any particular case of infringement of patent right were "practically and scientifically conversant with the subject?" Would he consider every one qualified who *called himself* a practical engineer or man of science, or would he have every man's qualifications made the subject of a preliminary judicial enquiry? The persons who gave evidence in favour of the plaintiff in this case would, most probably, all claim to be "practical" or "scientific," and yet Mr. Spiller has convicted them, one and all, of gross ignorance of the particular matter respecting which they gave evidence. It is evident, in short, that Mr. Spiller's ideal standard of excellence in jurymen is one which is, in practice, wholly unattainable. Neither is it necessary. We never yet knew of a case which could not, by proper care and pains, be made perfectly plain to the comprehension of any twelve men selected from those classes which furnish our special juries, (by whom commonly patent cases are tried,) whether they were previously acquainted or not acquainted with the branch

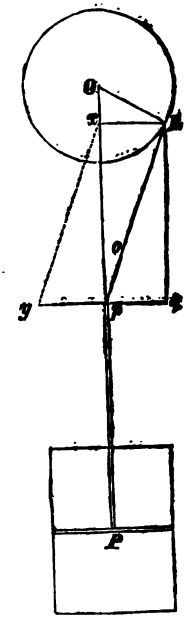
of art or manufacture to which it related. Mr. Spiller's excellent letter on the present case is itself a complete refutation of his jury-box theory. There is nothing in it which a person of education and average intelligence cannot perfectly understand,—nothing which would not, in all likelihood, have been duly appreciated by the jury in Goodfellow *v.* Barker, had it been properly brought before them.

### DISCOVERIES IN MECHANICS.

Sir,—In the present Number (1187) of your interesting periodical, page 349, I perceive your correspondent "E. A." has been amusing himself with certain alleged discoveries having reference to the mechanical theory of the crank. The author of the article to which I allude has pointed out what he conceives to be a glaring error in a paper by me on the subject; but the slip or error which he supposes I have committed, rests entirely upon his own misconception of the mechanical principles of constrained motions.

The observations of "E. A.," so far as they relate to the productions of Mr. Russell, seem to rest upon a better foundation; but as it is perhaps as well that I should confine my remarks to my own case, I shall here only state my impression that "E. A." may possibly have been misled in the first instance by an obvious irregularity in that gentleman's investigation. Mr. Russell appears to effect by a resolution of forces that which is, in reality, a composition.

Supplying the lines $pq$, $q$ R in the diagram, at the risk of being considered clumsy, it will appear that if $px$ represent the force in the direction of the piston-rod, $pq$ will represent the lateral strain at $p$ arising from the oblique position of the connecting rod. The force transferred along the connecting rod, instead of being a resolved force, as apparently indicated by Mr. Russell, is the resultant of the two forces $px$, $pq$, and its value, which is represented by $p$R, is therefore $px$ sec. R$px$, or P sec. $c$. In cases of constrained motion, "E. A." must not be surprised when he meets with forces greater than the original forces producing them. The development of power is quite another matter, and in the




course of transmission it cannot possibly be increased by mechanical agency alone.

I trust this brief notice may be sufficient to convince "E. A." that I have not fallen into the error imputed to me, as my time is too fully occupied at present to discuss the subject at greater length with the view of satisfying an unknown writer. I should wish it to be understood, however, that I have a favourable appreciation of his motives, and do not think his talents undeserving of consideration. I am, Sir,

Yours truly,

W. S. B. WOOLHOUSE.

26, Cornhill, May 12, 1846.

### THE PRISMATIC COLOURS—NEW THEORY.

May not the variety observable between one colour and another be attributed to a difference in velocity of a travelling ray of light, without supposing seven or any other number of *different kinds* of light?

Rays of caloric are said to have different degrees of velocity. We say, at any rate, that a finely polished silver teapot radiates its heat very much slower than a roughened-face black one. This is attributed to a difference in the structural arrangement of the radiating sur-

face. One kind of surface, therefore, radiates rays of heat differently, as to velocity, from another kind of surface. May we not suppose the same of rays of light? And go on, and suppose that different velocities have different effects—that is, make different impressions on that delicate organ, the eye—one velocity causing the sensation of seeing one kind of colour, and another velocity another kind of colour? If light be matter, then matter in motion will have different effects, having relation to the velocity of that motion.

A railway-train travelling slowly, and meeting an impediment, will experience much less shock than if travelling one hundred miles an hour. The organ of hearing, the ear, we know to be brought into action mechanically—by a vibratory blow of air on the drum of the ear, and this again acting on its internal nervous development. The eye has also its peculiar nervous development, and probably is acted on by light as purely mechanically as air acts on the ear. A man in a dark room, receiving a blow on the eyes, experiences the sensation of seeing a great light; but there is no light, for he is in the dark. Vision is a natural, physical, or animal sensation, and, like all other sensations, is produced by merely sensual contact, such contact creating more or less intensity of feeling, in proportion to its violence of action. A stone or bullet may be gently placed against your head, without your experiencing, perhaps, its presence. Let the same be projected at you from a little distance, and the result is different. Why may not the different sensations of colours be due to a difference in the velocity of a ray of light, such different velocities differently affecting the eye? Every colour may have its own velocity, or rather a ray in motion, of a given velocity, at all times, in the healthy eye, producing the same colour. The prismatic colours that are apparent in mother-of-pearl are attributed to the peculiar structural arrangement of its surface; and this peculiar arrangement can be given to silver, merely by taking an impression in this metal from the surface of the mother-of-pearl, when the silver, having now obtained the same structural arrangement of surface, becomes prismatic, like the former. Here the variety of colours is clearly due to the surface arrangement of the particles of silver. Mother-of-pearl will give to the eye, if both the eye and the object are rigidly stationary, but the appearance of one colour. It is from viewing it in another angle that the colour alters, but every fixed position gives its own colour. The secondary surfaces here are numerous, and each has its own power. May we not say that each of these surfaces has a distinct power of radiating a ray of light at a given permanent velocity, and that this velocity stimulates the eye more or less according to its intensity, without supposing *seven differently natured rays* of light? Take a piece of cold steel; notice its colour: it is permanent. Warm it, and it assumes another colour; cool it again, the new colour is permanent. Now the heat itself is not the cause of the change of colour, otherwise when again cold it should return to the original colour. But the effect of the heat was this: it altered the structural arrangement of the matter of the surface of the steel, and so has altered its radiating power, probably both for light and heat.

Now as to the rays of light from the sun. Presuming, again, light to be material, the sun is a globe, and at all times one point on its sphere must be nearer the earth than all other points. Call the nearest point its centre, and the most distant its circumference. Suppose all points of the sun to give off one, and only one kind or nature of ray of light, yet we must have different velocities in the several rays that reach the earth. If I shoot at a target at ten yards, the velocity of the bullet on reaching the target will be very much more than if I had shot from one hundred yards' distance. So the centre of the sun being (by its half diameter) nearer the earth than its circumference, the rays of light coming to us will have different velocities, according to their starting point from the sphere, having less and less velocity the farther from the centre. The centre rays may affect the eye with one colour, and those of the circumference with another, the intermediate space doing the same, and all together completing the several prismatic colours.

Again: the sun has a revolving motion. Take a circular wheel, paint all the prismatic colours on it after a certain order, give it rapid motion: the wheel will appear white. Presuming that different

velocities give different colours, the sun should appear to be made up of the prismatic colours. It should appear prismatic. And probably it would appear so if quite at rest, and this earth too; but the sun, like the wheel, revolves rapidly on its centre, and his motion and ours produce a constant interlacing of every ray projected from its surface, which make up, as it were, a balance of velocities, inducing thereby a kind of neutral state, or a concentration of every kind of ray in any single (so called) ray of light that can be subject to our observation.

J. M.

Battersea, April 27th, 1846.

P.S. Perhaps the continually changing colour of some stars or planets—exhibiting occasionally all the rainbow's rays—which appears at present unaccountable, may be due to a very slow revolution of these spheres on their axes, allowing time for the several rays to arrive at the earth without their velocities being disturbed.

## EXPERIMENTS ON STEAM ENGINE POWER.

Sir,—You favourably noticed some experiments I made on steam engine power as applied to cotton factories, at page 413, of Number 958 of the *Mechanics' Magazine*, and subsequently at page 438, of Number 1033, to which I would refer, and also to an excellent work by Mr. James Whitelaw, of Paisley, price 2s. 6d., entitled, "Description of Whitelaw and Stirrat's Patent Water Mill," in which the experiments referred to, and a great many others on steam and water power as applied to cotton and other mills are fully detailed.

The experiments made at that time show an average of 28 or $\frac{2}{11}$ of the gross power of a steam engine to be consumed by itself, and the mill gearing; and ·72 or $\frac{8}{11}$ by the machinery. And that good modern steam engines indicate double their mechanical power when fully loaded.

The standard for a mechanical horse-power is taken at 25 square inches area of cylinder, when the piston has a velocity of 220 feet per minute, or 23 square inches area, when the velocity is 240 feet per minute.

The result of those experiments gave to each mechanical horse-power

600 hand mule spindles with preparation : or
450 self-acting ditto ditto : or
200 throstle ditto ditto : or
20 looms with common sizing.

Each indicated horse-power is equal to

305 hand mule spindles with preparation : or
230 self-acting ditto ditto : or
104 throstle spindles ditto ditto : or
10½ looms with common sizing.

Including preparation,

1 throstle spindle = 3 hand mule, or 2¼ self-acting spindles.
1 self-acting spindle = 1⅓ hand mule spindles.

Exclusive of preparation, simply taking the spindle—

1 throstle spindle = 3½ hand mule, or 2⅝ self-acting spindles.
1 self-acting = 1⅜ hand mule spindles.

The following are the proportions in one horse-power of each.

| | | | | | |
|---|---|---|---|---|---|
| Hand mule spinning | ·68 | Self-acting spinning | ·7 | Throstle spinning | $\frac{6}{7}$ |
| Preparation..... | ·32 | Preparation..... | ·3 | Preparation..... | $\frac{1}{7}$ |
| | 1· | | 1· | | 1· |

Speeds of the above machinery—

| | | | |
|---|---|---|---|
| Common Throstles for 34's twist.——— | Spindles | 4,000 | revolutions per minute. |
| Self-acting Mules for 34 twist and weft.— | Ditto | 5,000 | ditto |
| Hand Mules ,, 34's ditto.——— | Ditto | 4,850 | ditto |

Looms for 37 inches cloth. 123 picks per minute. Common calicoes 60 reed Stockport, and 68 picks per inch. Average cost of fuel, 2s. 4½d. per indicated horse-power per week; or, ·095d. or $\frac{2}{21}$d. per hand mule spindle, including preparation, per week.
or, ·125d. or $\frac{1}{8}$d. per self-acting spindle, ditto ditto
or, ·273d. or $\frac{3}{11}$d. per throstle spindle ditto ditto
or, 2·8d. say $2\frac{3}{10}$d. per loom 37 inches broad, including winding, warping, and sizing per week.

Four and a half years have elapsed since I made the foregoing and other experiments, which are more fully detailed in the pages already referred to. Since that time great alterations have taken place, both in the speed of steam

engines, machinery, and methods of working them. It may be interesting to some of your readers, connected with the cotton trade, to learn the result of more recent experiments; and to gratify such I now detail a few made yesterday upon two excellent steam engines, at an establishment containing many of the latest and most approved improvements. The first steam engine and first machine commenced working in the Easter week, 1845, and the whole mill was fitted and completed in fifty weeks, or the beginning of March, 1846.

I may first premise, that there are three methods of estimating the power of a steam engine by Mr. Macnaught's dynamometer, or steam-engine indicator, viz.:

1st. Find the square inches area of the cylinder, which multiply by the velocity of the piston in feet per minute, and again by the average pressure indicated, will give the momentum: divide by 33,000, and $\frac{1}{10}$ of the quotient will be the effective horses power.

2nd. Multiply the square inches area of the cylinder by the velocity of the piston in feet per minute, and again by the average indicated pressure in pounds as above, which will give the momentum; divide by 44,000, and the quotient will be the effective horses power.

A horse can draw 200lbs. by a rope over a pulley at the rate of 220 feet per minute (200 × 220 = 44,000.)

3rd. Indicate the steam-engine and mill gearing when all the machinery is stopped, then indicate the steam engine when fully loaded, and ascertain the average pressure in both cases. Deduct the pressure of engine and gearing, from the pressure indicated when the engine is full loaded; the remainder is the nett or effective pressure required to turn the machinery, which multiply by the square inches area of cylinder, and velocity of piston as before; divide by 33,000, and the result will be the nett or effective horses power.

I prefer the second and third methods, and have adopted them in the following experiments:—

There are four boilers, commonly called fish-mouthed from their shape, or Butterley, each 30 feet long, and 8 feet wide. The steam gauge indicates a pressure from 8 to 9lbs. per square inches; it never exceeds 9lbs. These boilers were made by Mr. William Yates, Canal Foundry in this town, as were also the two steam engines, which are coupled at right angles, and nominally 60 horses power each. The cylinders are 40 inches bore, 7 feet stroke, and 21 strokes per minute.

Any steam engine may be rendered more powerful by increasing the speed; as in this case, they are nominally 60 horses power each; but mechanically 67 horses power; thus, if the standard of a mechanical horses-power be 25 square inches area of cylinder, when the piston has a velocity of 220 feet per minute: then

40 in. × 40 in. × ·7854 = 1,257 square inches area of cylinder.
7 ft. × 21 strokes doubled = 294 feet velocity of piston per minute.
1,257 square inches ÷ 25 = 50·3 horses power, at a velocity of 220 ft.
As 220 ft. : 50·3 horses power : : 294 ft. : 67 mechanical horses power.

*Diagram*, No. 1.

Friction of two steam engines, all the mill gearing and belts on the loose pulleys, 9·3 lbs.

*Diagram*, No. 2.

Preparation department 16·6 lbs.
9·3 lbs. friction of engines, &c.
7·3 lbs. nett or effective pressure.

By No. 3, rule.

1,257 square inches area of cylinder × 294 feet velocity of piston × 7·3 lbs. nett pressure ÷ 33,000 = 82 indicated horses power for the following, all in one card-room, viz.:—

1 large opener: beater 550 revolutions per minute.

3 double blowers, 40 inches wide: beaters 3 knives, and 1,350 revolutions per minute.

3 single lap machines, 40 inches wide: beaters 3 knives, and 1,350 revolutions per minute.

7 fans to the above, 1,050 revolutions per minute.

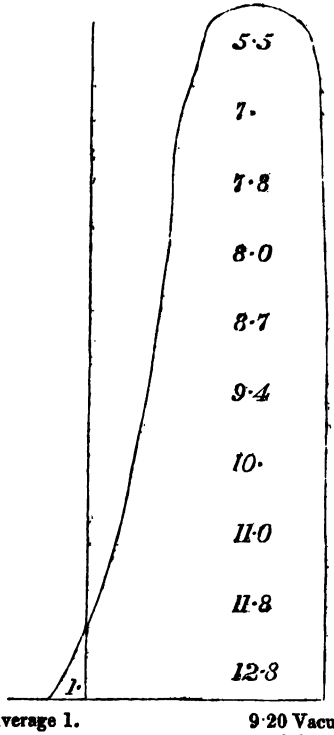
90 carding engines, 40 inches on the wire; main cylinders 130 revolutions; a coiling apparatus to each engine.

12 triple-headed drawing-frames each with 3 deliveries, 4 rows of rollers; front rollers 1⅛ inch diameter, and 350 revolutions per minute: a coiling apparatus to each delivery.

10 slubbing frames, each 72 spindles =

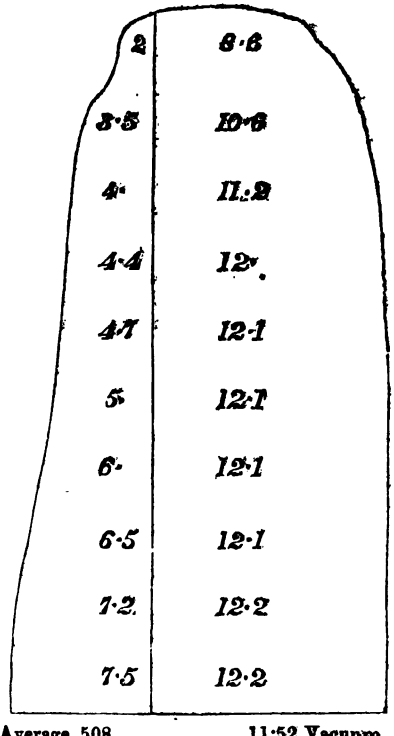
By Mr. Macnaught's Indicator.

No. 1.




Average 1. 9·20 Vacuum.
·10 Steam.
9·30 lbs.

No. 2.




Average 508. 11·52 Vacuum.
5·08 Steam.
16·6 lbs.

720 spindles; 4 rows of rollers; flies 450 revolutions per minute, and double pressure.

30 roving frames, each 120 spindles = 3,600 spindles; 4 rows of rollers; flies 800 revolutions per minute: Hibbert and Platt's double pressures.

*Diagrams*, No. 3*a*, No. 3*b*.

Both engines have steam applied, in order to indicate the power taken by the spinning department.

| | |
|---|---|
| No. 3*a*. engine . . . . | 9·18 lbs. |
| No. 3*b*. engine . . . . | 12·32 lbs. |
| | 21·5 lbs. |
| Deduct friction of two engines and gearing . . . . . | 9·3 lbs. |
| Nett effective pressure. . . . | 12·2 lbs. |

By No. 3 rule.

1,257 square inches × 294 feet × 12·2 lbs. ÷ 33,000 = 136 indicated horses power for three rooms of spinning, containing 30 pairs of self-acting mules on Messrs. Sharp and Robert's principle; each pair averages 1,500 spindles = 45,000 spindles: one-half of each, twist and weft. Spindles, 5,700 revolutions per minute.

*Diagram*, No. 4.—(Weaving)—15·9 lbs.

| | |
|---|---|
| Friction of two engines and gearing . . . . . | 9·3 |
| | 6·6 lbs. |

nett, or effective pressure. 1,257 square inches × 294 feet × 6·6 lbs. ÷ 33,000 = 7·4 indicated horses power for 4 winding frames, each 275 spindles = 1,100 spindles. Making 430 revolutions per minute.

8 warping mills (Mr. Kenworthy's patent.)

4 sizing frames (Messrs. Hornby and Kenworthy's patent.)

500 looms for 45 inch cloth, making 145 picks per minute with Messrs Hornby and Kenworthy's patent stop, and taking up motion applied, and a few of them with Mr. Bullough's swift motion. They weave calicoes, 60 reed Stockport, and 60 picks per inch.

*Diagrams*, No. 5*a*, No. 5*b*.

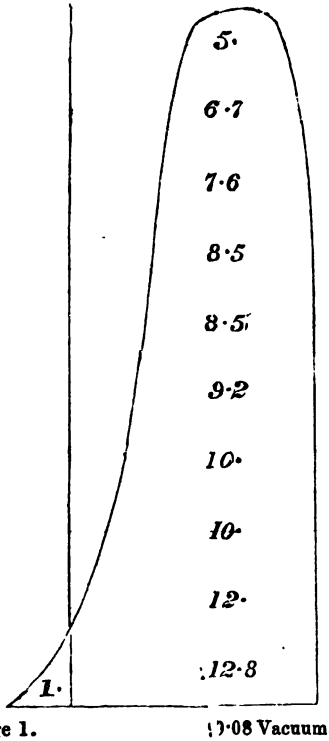
All the above machinery at work.

| | |
|---|---|
| No. 1 engine . . . | 16 67 lbs. |
| No. 2 engine . . . | 17·98 lbs. |
| | 34·65 lbs. total. |

By No. 2 rule :

1,257 square inches area × 294 feet, velocity of piston × 34·65 lbs. ÷ 44,000 = 291 indicated horses power, which agrees with the separate experiments.

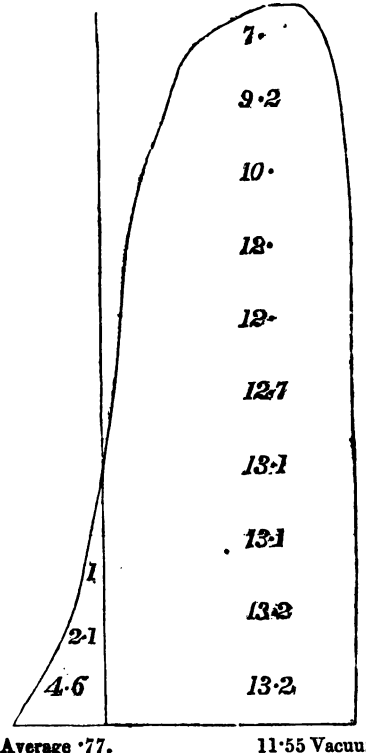
No. 3*a*.




Average 1. 10·08 Vacuum.
·1 Steam.

9·18 lbs.

No. 3*b*.

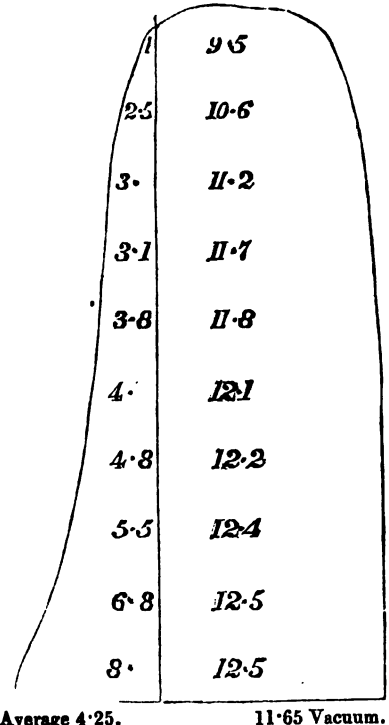



Average ·77. 11·55 Vacuum.
·77 Steam.

12·32 lbs.

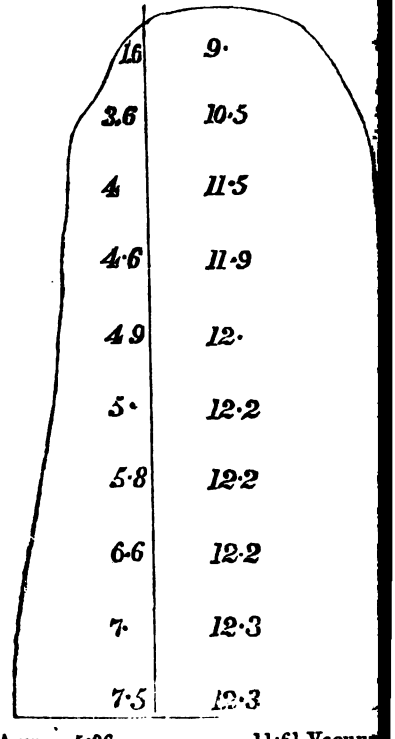
| | H. P. | |
|---|---|---|
| No. 2 diagram preparation . . | 82 | Nett. |
| No. 3 ditto spinning . . | 136 | ,, |
| No. 4 ditto weaving. . . | 74 | ,, |
| Total . . . . . | 292 | Nett indicated horses power. |

No. 4.




Average 4·25. 11·65 Vacuum. 4·25 Steam. 15·90 lbs.

No. 5*a*.




Average 5·06. 11·61 Vacuum. 5·06 Steam. 16·67 lbs.

| *Proportions.* | | | *Proportions.* | | |
|---|---|---|---|---|---|
| Friction of two engines and shafting | 9·3 lbs. | = ·263 | Preparation | ·375 or | $\frac{3}{8}$ |
| Ditto of all machinery separately | 26·1 lbs. | = ·737 | Self-acting spinning | ·625 or | $\frac{5}{8}$ |
| | 35·4 lbs. | 1· | | 1· | 1· |

| *Indicated Horses Power.* | | *Mechanical.* | |
|---|---|---|---|
| No. 2 diagram | 82 | = 37½ | Preparation. |
| No. 3 do. | 136 | = 62½ | Spinning. |
| No. 4 do. | 74 | = 34 | Weaving. |
| | 292 | | 134 |

One mechanical horse power to 450 self-acting spindles and preparation; or 720 self-acting spindles without preparation.

One mechanical horse power to 15 looms for 45 inch cloth, and 145 picks per minute, with its winding, warping, and sizing.

It requires 60 self-acting spindles and preparation, to one such loom.

One mechanical horse power will drive 300 self-acting spindles with preparation, winding, warping, sizing and weaving all complete.

I now subjoin an analysis of the machinery,

An average of 15 millions pounds of cotton, gives 19 oz. cotton to 16 oz. yarn.

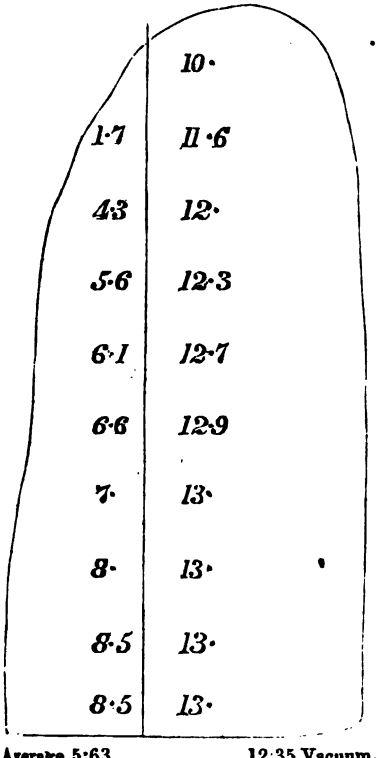
| | | | |
|---|---|---|---|
| One large opener for . . | 36,000 lbs. | yarn per week. | |
| Each double blower for . | 12,000 lbs. | ,, | ,, |
| Each single lap machine for | 12,000 lbs. | ,, | ,, |
| Each carding engine . . | 400 lbs. | ,, | ,, |
| Each drawing frame . . | 3,000 lbs. | ,, | ,, |
| Each slubbing frame . . | 3,600 lbs. | yarn per week, | or 50 lbs. per spindle. |
| Each roving frame . . | 1,200 lbs. | yarn ,, | or 10 lbs. ditto. |
| Each pair of mules . . | 1,200 lbs. | yarn ,, | or $\frac{4}{5}$ lbs. ditto. |

One-half No. 31's twist. One-half No. 32's weft.

| | | | |
|---|---|---|---|
| Each winding frame . . | 3,000 lbs. | No. 31 twist, | or 11 lbs. per spindle. |
| Each warping mill . . . | 1,500 lbs. | ,, do. | ,, ,, |
| Each sizing frame . . . | 3,000 lbs. | ,, do. | or 1,000 cuts per week. |

Each 45-inch loom 50 lbs. cloth per week.

No. 5*b*.




Average 5·63 12·35 Vacuum.
5·63 Steam.
17·98 lbs.

The tendency of all improvements is to better the condition of the operatives by diminishing his labour, and at the same time increasing the wages. In such an establishment as the one described, the nett average earnings of each individual (men, women, and children,) for 69 hours is 12s. 9d.; which is at least 1s. 6d. each person, more than would be received, where the machinery is old, besides having much harder work.

Coal is 10 per cent. dearer than four and-a-half years ago, when the average was 2s. 4½d. per indicated horse power per week, and each self-acting spindle costs $\frac{1}{8}$ of a penny, and each loom 2$\frac{5}{16}$d. per week.

Or yarn ·16d. per lb. spinning.
cloth ·09d. per lb. weaving.

·25d.; or, ¼d. per lb. in coal.

Notwithstanding which, the average is now 2s. 3d. per indicated horses power per week, and each self-acting spindle costs ⅛d., and each loom 4d., per week, or 32's yarn ·162d. per lb. spinning.
cloth ·080d. ,, weaving.

·242 per lb.; or ¼d. per lb. cost of cloth in coal.

In the hope that these statements may induce others to make similar communications,

I am, yours, respectfully,

JOHN BAYNES.

Park-place Mills, Blackburn,
April 18, 1846.

## ABATEMENT OF THE SMOKE NUISANCE.

We are glad to observe the successful exertions which are making in some of the principal manufacturing towns to abate the smoke-nuisance. The statements which we are about to quote from two of our provincial contemporaries, prove beyond all pos-

sibility of doubt or cavil, that the evil is one which *can* be completely removed without the least damage to any one, and immense benefit to all. In the absence of a law to compel its universal abatement (a piece of legislation, perhaps, of too enlightened a character to be speedily looked for) nothing can contribute so much to render all laws on the subject unnecessary, as to make known far and wide, such notable examples of reform as those we now present to our readers:

*From the Manchester Guardian.*

We are aware that some persons regard any statement, that the smoke nuisance has really altogether abated in Manchester, as altogether fallacious and delusive. But till very recently, there was quite as strong an incredulity, in many quarters, as to the possibility of effecting any considerable decrease of the nuisance. From the stronghold of unbelief, the most inveterate supporters of smoke have recently been driven by the cumulative evidence of facts; and what is the most striking and satisfactory proof of the progress of opinion in this matter, is that exhibited by several parties, who having been summoned before the magistrate, under the Police Act, for creating nuisances of this description, were, by the decision of the bench placed amongst that class of persons who, being "convinced against their will, are of the same opinion still;" or, perhaps it would be more correct to say, though convicted, they were not convinced. They even declared in court, that it was not possible to do more than they had done; and that, from some peculiar causes, their chimneys could not possibly emit less smoke than the quantity which had subjected them to penalties for its excess. Well, on Tuesday last, other parties appeared, on summons, at the Borough Court, to answer similar charges; and the town-clerk, in supporting the informations, took occasion to refer to the present state of previously-convicted chimneys, now that they were put on their probation. Amongst these was the chimney of the Oxford-road Twist Company's mill. Mr. Cooke, when before the court, said that the company had expended a large sum; had done all that was in their power to accomplish; and that little further improvement could be attained. The same chimney has recently been tested in the same manner, and for the same time, as before; and the contrast is most striking. The following are the proportions of the three degrees of smoke within the hour, on an average of nine hours, at both periods of observation:—

| | *Before.* | *Now.* |
|---|---|---|
| Dense smoke ..... | 15 minutes | 0⅕ |
| Moderate ..... | 21¼ ,, | 13 |
| None perceptible .. | 23¾ ,, | 46⅘ |

This is certainly a most remarkable improvement, after the acme of actual perfection was supposed to be reached. Yet this was accomplished without the expenditure of a single additional shilling in the alteration of furnaces!—Another case is that of Messrs. Withington, Hilton, and Wood, whose chimney exhibits an improvement still more remarkable:—

| | *Before.* | *Now.* |
|---|---|---|
| Dense smoke ..... | 19½ minutes | 0¾ |
| Moderate ..... | 34 ,, | 18½ |
| None perceptible .. | 6½ ,, | 40¾ |

A third remarkable case is that of Messrs. Lord and Scott, David-street, whose chimney was one of the worst in the town:—

| | *Before.* | *Now.* |
|---|---|---|
| Dense smoke ..... | 46 minutes | 0 |
| Moderate ..... | 13 ,, | 9½ |
| None perceptible .. | 1 ,, | 50½ |

Another instance we may give, that of Mr. Sibson Rigg, who also doubted very much whether he could any further abate the nuisance from his chimney:—

| | *Before.* | *Now.* |
|---|---|---|
| Dense smoke ..... | 19⅜ minutes | 1 |
| Moderate ..... | 23 ,, | 4½ |
| None perceptible .. | 17⅓ ,, | 55½ |

These are sufficient to show the great improvement practicable, beyond the expectations of those who had previously expended much time, labour, and money, in endeavours to abate the nuisance. But these are only samples of a large and increasing class, who are zealously doing their utmost to suppress the nuisance; including not only the comparatively few individuals who have been summoned for violation of the law, but the much larger number of those, who, without any such stimulus, have succeeded so far in abating the smoke from their chimneys, as to have attained immunity from the informations of the smoke inspectors. The sceptics as to smoke abatement, then, are at length placed in a very small minority; and public opinion being now based on the strong foundation of incontrovertible facts, there is no excuse left for those who still continue to poison the atmosphere of their neighbourhoods by these sooty nuisances. A remarkable proof of the unanimity of public opinion on this subject is presented in the fact, that not one of the score or two of individuals who have been summoned before the magistrate for offences of this description, has ever offered

the slightest resistance; but, on the contrary, all have expressed their readiness to do whatever was possible to comply with the requirements of the Act. It is now established that the law is not harsh or unjust; that it requires nothing but what is perfectly within the power of the owners of furnaces and chimneys to accomplish; and ere long, in the progress of opinion on this subject, a chimney frequently emitting dense smoke, will be regarded as the external sign of a bad manager and a bad neighbour.

One word as to the means of accomplishing all that can be wished. No doubt the great perplexity of those who have desired to alter their furnaces so as to consume the smoke more effectually, has been what the French call the embarrassment of abundance. Amongst the host of patented and unpatented inventions for the cure of smoky chimneys, parties were sorely troubled to choose, and every chimney-doctor was not alike successful. But besides some two or three very simple rules, which are now pretty generally understood, there is one little expedient, which, though hitherto almost wholly overlooked, is worthy of general attention. In one case, that of the Oxford-road Twist Company, it proved to be a specific, after all other means had failed. This is simply to make it the *interest* as well as the duty of the stoker to consume as much smoke as possible. Advanced wages for *maximum* smoke burning, with deductions for letting the chimney fall under the penality,—this simple plan has been proved in more cases than one to be a very effectual remedy, and in some instances where the chimney-doctors' prescriptions have failed, the stoker's care and attention have accomplished all that could be desired. With all these means at command, with all these accumulated proofs of the most complete success, we hope to hear no more sceptical doubt as to the possibility of the suppression of this nuisance; but to find our atmosphere becoming clearer and purer, till it shall cease to become a reproach to Manchester.

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*From the Midland Counties Herald.*

(CORPORATION MEETING.)—The clerk read the subjoined report from the Steam-engine Committee:—

The Steam-engine Committee report that they have devoted their attention to the matters entrusted to them by the Commissioners at large, with a view to suppress the nuisance arising from the unconsumed smoke of steam-engines, and the following is the result of their labours:—Your Committee have now before them a complete register of all the steam-engines within the limits of the Act. They amount to 194. Of this number seven are not now at work. Of the remaining 187, your committee have the satisfaction of reporting that 82 now give out no smoke to be complained of, their owners having adopted apparatus calculated to consume the smoke, and having, moreover, taken care that their servants carefully attend to the apparatus so applied, without which no attempted remedy is effectual. In 47 other cases, your committee report that apparatus has been applied with partial, but not complete success; and with regard to 23 other engines, although some means have been adopted, the result is not satisfactory. Your committee are convinced that in these two classes the failure is attributable to neglect on the part of the servants employed: and that, with proper care and attention, the nuisance complained of would be entirely abated, or rendered so trifling as not to require notice. Your committee trust that an appeal from the commissioners to this class of their fellow-townsmen will have the desired effect without resort to legal proceedings. With respect to the remaining 35 of the steam-engines now at work within the limits of the Street Act, your committee cannot favourably report. They have received, it is true, in many cases of this class, promises to apply remedies, which promises, they trust, will be performed; but with regard to some others who, in spite of repeated notices and remonstrances, still continue the annoyance to their neighbours and the town at large, they have been reluctantly compelled to resort to legal proceedings for recovery of the penalties incurred, amounting to £1,000; and your committee will pursue this course, with regard to these and other parties, if they obtain the sanction of the commissioners at large. Your committee now await the sanction of the commissioners with regard to their past proceedings, and instructions as to their future course.

Mr. B. Cheshire moved, that the report be adopted, and the committee authorised to take such further steps as they might deem necessary.... Mr. James Turner, in seconding the motion, observed that on the previous Thursday he had driven round and inspected the various chimneys; and he found that, especially at the west-end, the improvement was very great. The commissioners were, he thought, in a position to say, with regard to the smoke nuisance, that what can be done must be done, and that means can be adopted with which it would be impossible to make smoke. He had stood for some five or ten minutes beside one chimney where those means had been adopted, and it was impossible to see any

smoke rise from it. The adoption of the invention had done away with the necessity for having a fireman: a boy at four or five shillings per week was sufficient to look after the fires.... Mr. John Cadbury observed that the question as to the consumption of smoke rested entirely in the hands of owners of steam-engines. To relieve the public of smoke would require some pecuniary sacrifice, an outlay of some seven shillings per week, perhaps, for a person to attend entirely to the fires; but if that were done, the committee were enabled by experience to say that the nuisance could be prevented. He had said that there would be a sacrifice, but he should rather have said that, if the proper steps were taken, there would be a positive saving in the item of fuel. Those of the ratepayers who lived in the neighbourhood of the steam-engines were grateful to the commissioners for having relieved them of the nuisance, while those parties whose chimneys had been cured were grateful to the commissioners for having enforced their own laws.... The resolution was seconded and carried.

It is to be regretted that neither of the preceding statements furnishes any information as to *the particular plans of consuming smoke that have proved most successful.* It is evident that a knowledge of this would be of great use in inducing other towns to follow the excellent example of Manchester and Birmingham. We hope that some of our many readers in these towns will enable us to supply the omission.

## AMERICAN EXPERIMENTS IN PROPELLING, WITH SUBMERGED HORIZONTAL PADDLE-WHEELS AND SCREW PROPELLERS.

(From the Franklin Journal.)

*Report of Committee of the Franklin Institute to the Secretary of the Treasury of the United States.*

To comprehend the construction and action of Hunter's submerged wheel, we have only to imagine an ordinary paddle-wheel, moving at the side of a boat round a vertical instead of a horizontal axis, with the paddles attached to a water-tight and empty cylindrical drum, and the whole immersed below the surface of the water. If placed entirely in the open water, it is evident that the revolution of a pair of such wheels would produce no motion in the vessels, since any two opposite paddles must exactly counteract each other. That the boat may be propelled at all, therefore, it is necessary that the greater part of the paddles be made to revolve in dead water, by surrounding them with a casing of wood or iron. A very few —three or four—of the outside paddles are thus rendered efficient in the propulsion of the vessel, while all the force required to move the others through the water is wasted. This propeller, therefore, differs, in its action, from the ordinary side wheels of steamboats, only in the circumstance that, in the latter, the inefficient paddles move through the air, a medium presenting slight resistance,—while, in the former, the inefficient paddles move through water, a medium of great resistance. It is perfectly manifest then, that the latter must require a vastly greater power than the former to produce the same effect.

The Loper propeller is one of the many varieties of the screw propeller,—an arrangement which, in some of its forms, has been long since devised and employed for driving vessels through the water, and which possesses the advantage, so important in many cases, and especially in war vessels, of being submerged under the water. As a comparison of the Loper propeller with others of the same class, is not asked of the committee, it is not deemed necessary to describe its peculiarities in this report.

For a simple and perfectly satisfactory comparison of the relative merits of the two propellers in question, the best test is that which would be offered by their respective operations if attached to the same vessel, and set in action by the same engine. Such a comparison is fortunately presented by a series of experiments made with the U.S. steamer *Spencer*, the details of which are given in the printed reports of Captain Alexander V. Fraser. As the vessel and engine were the same in both cases, it is not necessary that they be described; since, for a mere comparison, it is the variable quantities only that need enter into the computation.

*Steamer Spencer, with Hunter's propellers.*—In a trial made in New York bay, in September, 1844, with Hunter's submerged wheels attached to this vessel, it appears, from Captain Fraser's report, that she moved through the water with a speed of 6·5 miles an hour.

Now the work accomplished, in the propulsion of a vessel, for a given time, is proportional to the resistance offered by the water, and to the distance passed over. But the first of these is known to be, in such cases as the present, sensibly as the square of the velocity, and the second is evidently as the velocity itself. Therefore, the whole work done is proportional to the

product of these two, or to the cube of the velocity. Consequently, in the present case, this is as the cube of 6·5, or 274·6.

The power exerted by the engine in doing this work is proportional to the effective pressure of the steam, and to the number of strokes of the piston in a given time, or it is proportional to the product of these two variable quantities.

Now, in the example in question, the pressure of the steam (as indicated by the safety-valve, and therefore to be increased by one atmosphere) is reported to have varied from 75 to 80, or to have averaged 77·5 lb. to the square inch; and the steam was cut off at one-third of the stroke of the piston. From these data, the mean pressure in the cylinder is estimated at 64·54, and the effective pressure, after deductions for friction, according to the formula of Pambour, at 41·86.

The number of revolutions of the engine (or of double strokes of the piston) is reported to have been from 53 to 54, or to have averaged 53·5 per minute.

The effective power of the engine (or rather of the engines, for there were two) was therefore proportional to 53·5 × 41·86, or to 2239.

*Steamer Spencer, with Loper's Propellers.*—In May, 1845, Loper's propellers were substituted in the *Spencer* for Hunter's wheels, (the engines being the same and in the same condition,) and experimental trips were made on the Delaware, and were witnessed by the Committee of the Institute. For the required comparison, the trip made on the 23rd of May, from New Castle, to the Delaware Breakwater, is selected.

On this occasion, the mean velocity attained was 9·38 miles an hour, and consequently the labour performed is proportional to the cube of this number, or to 825·3.

The average pressure of the steam was 49·09, (or more properly, by adding the atmospheric pressure, 49·09 + 14·70 = 63·79,) and it was cut off at the half-stroke. From these data, the mean pressure in the cylinder is estimated at 54·03, and the effective pressure, after deducting friction, at 32·85.

The mean number of revolutions of the engine was 44·45 per minute.

The effective power of the engine was therefore proportional to 44·45 × 32·85, or to 1460.

*Comparison of the Results.*—From these results we find that the power exerted by the engine with Hunter's wheels, was to that with Loper's propellers, as 2239 to 1460, or as 1 to 0·652; while the work done by the wheels was to that done by the propellers as 274·6 to 825·3, or as 1 to 3·005.

Hence it appears that Loper's propeller does 3·005 times more work than Hunter's wheel, with 0·652 of the power; and therefore, with the same power, would be $\left(\frac{3005}{652} = 4{\cdot}6\right)$ four and six-tenths times more efficient.

This is a very remarkable result; but it is one which should have been anticipated from the evident waste of power inseparable from the use of the Hunter wheels, and it shows that their further employment ought to be abandoned.

A change from the Hunter to the Loper propeller was also made in the U.S. steamer *Water Witch*, and opportunities of witnessing her performance with the latter propeller were presented to the committee, and full notes of the results have been preserved. But unfortunately, although this report has been long delayed for the purpose, satisfactory information has not yet been procured as to the performances with the submerged wheel, the essential element of the speed attained being so uncertain that it cannot be made use of for calculation. Further efforts have been made to procure the necessary data for a just comparison of the two propellers in this case; and if they shall be successful, it will be in the power of the committee to make an important addition to this report.

By order of the Committee,

WILLIAM HAMILTON, *Actuary.*

Philadelphia, December 15, 1845.

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*Account of Experiments with the U. S. Iron Steamer "Water Witch," referred to in the preceding Report.*

This vessel was originally 100 feet 6 in. long, 21 feet 4 inches beam above the water line, and 16 feet 9 inches below, (her form being of that peculiar kind advocated by Lieut. Hunter,) and 9 feet 9½ inches depth of hold. She was fitted with Lieut. Hunter's patent submerged wheels, 16 feet diameter, and two high pressure engines, having pistons 22 inches diameter and 4 feet stroke. When tried by a committee of Naval Engineers, at Norfolk, in May, 1845, the mean draft of water was 7 feet 7½ inches, and the maximum speed attained, ascertained by the "*chip log*,"* was 6½ knots, equal to 7·54

* In steam vessels, the "chip log" cannot be relied upon for ascertaining the speed, because the stern current created by the action of the paddle-wheels, or other propellers, causes it to indicate a higher speed than that of the vessel, the amount of

statute miles per hour. "The pressure of steam in the boiler was 80 lbs. per square inch excess above the atmosphere. The throttle valves were wide open, and the engines were working 'full stroke,' that is, without expansion. The number of revolutions per minute was 28."

The velocity of the extremity of the paddle was 15·98 miles per hour, and the speed of the boat was, even by "*chip log*," only 7·54 miles per hour, being 0·47, or less than one-half of the speed of the wheels.

The *Water Witch* was afterwards taken to Philadelphia, cut apart in the middle, lengthened 30 feet, and increased about 6 inches in width. The propellers of Lieut. Hunter, and the large engines by which they were actuated, were removed, and smaller engines and Loper's propellers substituted. The new engines have cylinders 20 inches in diameter, and the stroke of the pistons is 2 feet. They are supplied with steam by one boiler, having about one-half the quantity of heat-absorbing surface that was contained in the two boilers attached to the first engines.

On the 18th of October, 1845, after the alterations had been completed, a committee from the Franklin Institute made several experimental trips in her for the purpose of ascertaining her speed. The space run over was from a point in the Delaware ranging with the southern side of the large ship-house at the navy-yard, to the pier at Greenwich Point; the distance between these points being precisely 2·19 statute miles. The vessel was run considerably past the marks each way, so as to be under full headway while passing them, and the time of passing was carefully noted. During the first trip, (down and back,) the steam was maintained at a pressure of 60 lbs. per square inch on the boiler; during the second trip at a pressure of 46 lbs. per square inch; and during the third and last, at 32 lbs. per square inch. The following is extracted from the minutes of the committee:

"Experimental trips on board the U. S. steamer *Water Witch*, October 18, 1845.

"Draft of water at bow 5 feet 4 inches.

"Do. do. stern 6 feet 10 inches.

"Left the navy-yard a few minutes before 11 o'clock, A.M., passed up the river and turned. Tide slack, or very slightly young flood. Passed the range of the south side of the large ship-house 11 o'clock 40 seconds, steam 60 lbs. in boiler, engines working expansively, cut off at half stroke.

| No. of Trip. | Pressure of Steam.* | Running Time. | | Average number of Revolutions. | Tide. |
|---|---|---|---|---|---|
| | | Down. | Up. | | |
| No. 1. | 60 | 14 m. 48 sec. | 13 m. 40 sec. | 61·9 | Low slack water. |
| No. 2. | 46 | 21 48 | 15 15 | 54·4 | Flood and strong. |
| No. 3. | 32 | 30 25 | 14 38 | 45·5 | Strong flood. |

"Passed range of the ship-house at 45 minutes past 1 o'clock, rounded-to, and landed at the navy-yard a few minutes past 2 o'clock. Whole running time occupied by the experiments 2 hours and 45 minutes."

From this data it is proposed to ascertain,

1st, The speed of the vessel through still water; and 2ndly, The ratio of the resistance of the vessel at different velocities, or, in what power of the velocity the resistance increases.

First, the speed of the boat:

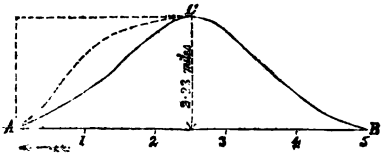
If the velocity of the tide were constant during the time of running each trip, the speed of the boat through still water could be easily ascertained by reducing the speed when running with and against the tide, to the same unit of time, and taking the mean. This is the usual way of estimating the speed of a boat running in current, but it is evident that it can be correct only when the flow of the current is constant. Now, from the minutes of the committee, we see that the experiments commenced at "slack water" and ended with "strong flood." Consequently, in order to ascertain the true speed of the boat through the water, we should know the velocity of the tide at all the different stages from "slack water" to "strong flood." In the absence of any information on this point, derived from direct observation, I have endeavoured to form an approximation from the experiments themselves. It occurred to me that the increase and diminution of the velocity of the tide might be represented by a curve, by means of which the necessary correction for its varying influence might be made. I supposed that the form of the curve would be similar to the outline of the section of a wave, such as is shown in full line, in fig. 1. The intervals of time being represented on

error varying with the recession or slip of the propellers through the water. In the *Water Witch*, the slip of the wheels being enormous, the error in the speed indicated by the "chip log" must have been very considerable.

* The pressures given by the committee are 60 lbs., 45 lbs., and 30 lbs., respectively, but a slight correction for the weight of the lever and appendages of the safety valve was omitted by them.

the base line, A, B, and the different corresponding speeds being measured off at right angles to the line, would be the ordinates to the curve.*

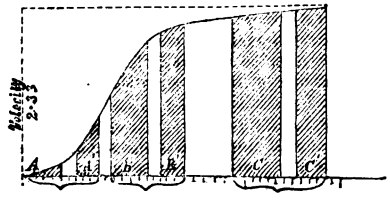
Fig. 1.




Hours.

It being low tide and slack water at A, I supposed that the velocity of the current would increase gradually and attain a maximum, as shown by the figure at C, then diminish and come to rest again at B, or slack water at high tide. The height of the curve, or the line C, c', corresponding to the maximum velocity of tide, should represent 2·33 miles; and the line, A, B, should represent 5 hours, that being the mean time from low to high water in the Delaware, at the navy-yard.† The experiments of the committee enable us to approximate to the position of three points, and developing a curve through them, the figure shown by dotted lines in figure 1 is produced, differing very widely from the form which was expected. From this, it appears that the velocity of the tide increases very rapidly, and quickly attains nearly the maximum velocity, which it maintains nearly constant for some time. In fig. 2, the portion of the curve embraced by the experiments, is represented having the intervals of time occupied by the boat in making the different passages up and down, shown upon it by the shaded portions; thus giving a graphic representation of the influence of the tide.

Fig. 2.




A—First trip down, —against tide.
A'— do. up, —with tide.
B—Second trip, down, —against tide.
B'—Second trip up, —with tide.
C—Third trip down, —against tide.
C'— do. up, —with tide.

By the aid of this curve, the speed of the boat has been ascertained to be as follows:

First trip down—Against tide, time 14·8 minutes, and speed by the land $\frac{60 \times 2{\cdot}19}{14{\cdot}8} =$ ..... 8·878

Add tide as determined by the curve 0·100

Speed of the boat through still water 8·978

First trip up—With tide, time 13·66 minutes,

speed $\frac{60 \times 2{\cdot}19}{13{\cdot}66} =$ 9·541

Less tide ascertained by the curve .. ·550

8·991

Mean, up & down, 8·985 miles per hour.

Second trip down—Against tide, time 21·8 minutes speed $\frac{60 \times 2{\cdot}19}{21{\cdot}8} =$ 6·030

Add tide, (by curve,) ..... 1·900

Speed of boat ..... 7·930

Second trip up—With tide, time 13·25 minutes speed, $\frac{60 \times 2{\cdot}19}{13{\cdot}25} =$ 9·917

Less tide, (by curve,) ..... 2·000

Speed of boat ..... 7·917

Mean, up and down, 7·923 miles per hour.

Third trip down—Against tide, time 30·42 minutes, speed $\frac{60 \times 2{\cdot}19}{30{\cdot}42} =$ 4·320

Add tide (by curve,) ..... 2·250

Speed of boat ..... 6·570

Third trip up—With tide, time 14·633 minutes, speed, $\frac{60 \times 2{\cdot}19}{14{\cdot}633} =$ 8·980

Less tide, (by curve,) ..... 2·340

Speed of boat ..... 6·640

Mean speed, up and down, 6·605 miles per hour.

The speed of a vessel, within moderate limits, will vary very nearly as the number of revolutions of the propeller. This furnishes approximate means of testing the correctness of the speeds we have just determined, by comparing them with the revolutions. This comparison, taking the speed in trip No. 1 as a starting point,

* The curve is drawn as described by Mr. J. Scott Russell.

† From observations made for the coast survey.

is given in the 5th column of the following summary. The speed computed in the usual way, by taking the mean with and against the tide, is also given in the 6th column.

| Trip. | Press of Steam. | Mean number of Revolutions. | True Spee d by Curve. | Speed by Revolutions. | Speed by Mean |
|---|---|---|---|---|---|
| 1st. | 60 lbs. | 61·9 | 8·985 | 8·985 | 9·209 |
| 2nd. | 46 ,, | 54·4 | 7·923 | 7·888 | 7·973 |
| 3rd. | 32 ,, | 45·5 | 6·600 | 6·597 | 6·650 |

From this table it appears that the speed, estimated in the usual manner, exceeds the true speed in all the trips.

Secondly, Comparison of the resistance with the velocity.

As the machinery was precisely the same in all the trips, the tractive force exerted by the engine may be represented by the *effective* pressure on the piston. The pressure in the boiler has been already given. Ascertaining the mean pressure, and deducting friction, &c., (according to Pambour's formula.) the mean effective pressures for each trip is found to be as follows. With

| | | | | | lbs. per sq. in. |
|---|---|---|---|---|---|
| 60 lbs. pressure above atmosphere | =74·7 lbs. | total pressure, | the mean effective pressure is | | 38·21 |
| 46 lbs. | do. | =60·7 lbs. | do. | do. | 29·08 |
| 32 lbs. | do. | =46·7 lbs. | do. | do. | 19·84 |

Comparing, now, the effective pressure on the piston, (which, as we have said, represents the force exerted by the engine in the direction of the motion of the vessel, or what may be called the traction of the engine,) with the velocities, we may ascertain in what ratio of the velocity the resistance increases. This may be conveniently done in tabular form, thus:—

| Trip. | Total pressure in Boiler. | Effective pressure on Piston. | Speed of the boat through still water.—In miles. | Ratio of effective pressure 19·84 being unity. | Resistance of vessel in powers of velocity. |
|---|---|---|---|---|---|
| 1st. | 74·7 | 38·21 | 8·985 | 1·92 | 2·11 |
| 2nd. | 60·7 | 29·08 | 7·923 | 1·46 | 2·08 |
| 3rd. | 46·7 | 19·84 | 6·600 | 1·00 | |

Making some allowance for error, both in the observations of the committee and in the estimate of the effective pressure on the piston, (which has been used as the measure of the resistance of the vessel,) I think we are justified in coming to the conclusion that the resistance of this vessel at least, varies as the square of the velocity. Some calculations made from a former series of experiments with the same vessel, but under different circumstances of immersion and tide, showed that the resistance increased almost exactly as the square of the velocity. A record of the experiments was not made by the committee, and the calculations were not preserved.

The method of ascertaining the resistance of a vessel here made use of is not quite satisfactory, because it is not exact. Nevertheless, it appears to be sufficient to show that the generally received law is true, viz.: "that the resistance to a body moving in a fluid varies as the square of the velocity, and the power required during *a given time* to overcome that resistance, varies as the cube of the velocity."

The correctness of this law has recently been denied, and the calculations in this paper were made originally for the purpose of satisfying a friend sceptical upon this point. I send them for publication, believing that the facts given by the committee are valuable, and hoping that the remarks they have suggested may not be altogether uninteresting or useless.

J. H. T.

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ROYAL CORNWALL POLYTECHNIC SOCIETY.—COLLEGE FOR CIVIL ENGINEERS.

The "Thirteenth Annual Report of the Royal Cornwall Polytechnic Society," for 1845, is now before us. We have often had occasion to notice with approbation the pro-

ceedings of this institution, and are glad to observe that it still continues in a prosperous condition.

The quantity of original matter in the present report is less than some of those for former years; but what there is, is of a valuable character. We may notice in particular a paper on "Certain Pseudo-Morphous Crystals of Quartz," by R. W. Fox, Esq.; "Observations on the Disease which has injured the Potato in the Present Year," by Jonathan Couch, F.L.S., (illustrated by a number of engravings;) and a "Description of the Man-engine at United Mines, Gwennap," by Captain W. Francis; —which last we propose at some convenient opportunity to transfer to our pages.

Among the stranger-visitors who were present at the last annual meeting, honourable mention is made of Professor Cowie, the principal of the College for Engineers. Sir Charles Lemon, Bart., the president of the Society, in introducing Mr. Cowie to the notice of the meeting, observed, "I have lately visited the College at Putney, and can undertake to assure you that the means of education there provided are *the most ample and perfect of their kind.*" No one is better qualified than Sir Charles Lemon to pronounce a sound opinion on any educational subject. Professor Cowie gave, on a subsequent day, a sketch of the course of instruction pursued at the college, which went a great way to sustain the character given of it by the honourable baronet. We subjoin the report of the professor's address, given in the Society's Report; though without forgetting, or wishing to be thereby absolved from the promise, which we ourselves are under, to make the merits of the college, as now conducted, better known to our readers, and which we propose at no distant day to redeem:

"Professor Cowie then stated that the student in this college is carefully trained in mathematics and natural philosophy, and courses of chemical lectures are supplied to him. The principles and practice of machinery, the art of general construction, including buildings and excavations, tunnelling and hydraulic architecture; the art of surveying and levelling, drawing contour lines, mapping and surveying in mines, are all taught by competent professors. This is the course of theoretical instruction; but to obviate the just objection, that theory did not make a practical man, they joined therewith practice also. In chemistry the student is taught manipulation in the laboratory. In the course of construction, experiments are made before him, and by myself, on the strength of materials, and he is taken by a professor to visit all public works of magnitude in progress in the metropolis, or to be reached within an hour or two by railway. The student is also provided with an extensive room, where the manufacture of machinery is carried on by steam-power, which they were enabled to do by their noble president, the Duke of Buccleuch. The student is also called upon to survey and level, and lay down railway courses in the open fields, in districts assigned to him. He prepares and draws out specifications of works, and in fact has at his command all the knowledge he could acquire from the theoretical classes, and the offices of the surveyor, the railway engineer, the general builder, and the manufacturing engineer. Great care is bestowed in giving the student a thorough knowledge of *descriptive geometry*, by which, in preparing working drawings of machinery, he is made a *scientific* and not a mere copying draughtsman. Geology, which is applicable to mining pursuits, mineralogy, and metallurgy, each receive particular attention. Mr. Carne, of Penzance, had kindly promised to provide them with everything they required as specimens in that way. Modern languages—the French and German—also form a part of the course of education in this college.—The professor then dwelt at considerable length on the advantages, which such an education as this college afforded, conferred on gentlemen who managed their own estates, or those intended for the military profession, or on those who emigrated to other countries. The cost for a resident student was 130*l.* a year, which was not a large sum considering the great outlay in the buildings, &c., and also the immense sum which it cost to procure a similar education before this institution was established. He hoped, however, if the public enabled them, by increasing their prosperity, to provide for students of inferior means access to the institution, as well as the wealthy."

## RECENT AMERICAN PATENTS.

[From Mr. Keller's Abstracts in the *Franklin Journal.*]

FOR IMPROVEMENTS IN THE ROTARY STEAM-ENGINE. *James Black.*—The pa-

tentee says,—"My rotary steam-engine is of that kind which is usually denominated a re-action engine, as it is made to discharge the steam which is admitted into it from the ends of two or more arms, the discharge orifices, at the outer ends of which are in the direction of a tangent to the circle in which they rotate, being in this respect similar to the well-known Avery's rotary engine, and others operating on the same general principle; I have, however, ascertained experimentally that the power of such an engine may be considerably increased by admitting water into the steam arms, just behind the point at which the discharge of steam takes place; such water entering said arms in the direction of the radii of the circle of rotation, and consequently at right angles, or nearly at right angles to the current of effluent steam. To effect this, I place the axis of my rotary engine vertically, and extend the arms for the passage of steam horizontally, curving them at their outer ends so that their steam issues shall stand in the direction above indicated. Steam is to be admitted into the revolving axis at its lower end, and is to flow thence through the steam arms. The steam arms are to revolve within a circular case, or drum, standing horizontally, and there is a depression towards the centre part of this drum which is to constitute a reservoir of water, or other fluid, from which the current is to be supplied that is to pass into each of the steam arms, and into which it is to return after it has performed its office. To carry this water or other fluid to its destined point, I use a second series of tubes, the outer ends of which enter the steam arms as above stated, whilst their inner ends are bent down so as to dip into the above-named reservoir; the result of this arrangement is that each of the water tubes operates, when the steam arms are set in motion, as a centrifugal pump, raising a portion of water from the reservoir, and delivering it into its appropriate steam arm."

*Claim.*—"What I claim therein as new, and desire to secure by letters patent, is the combining with each of the steam arms a tube, one end of which shall dip into a reservoir, which is to contain a portion of water or other fluid, which fluid, in its heated state, is to be carried into the steam tube by the centrifugal action of the engine, and is to enter the said steam tube, near the orifice, for the emission of steam, and at right angles, or nearly so, to the course of the effluent steam; the said water or other fluid being allowed to flow back into the reservoir, so that it may be continuously used for the purpose and in the manner herein set forth.

"I do not claim the introduction of a jet of cold water into the revolving arms for the purpose of condensing the steam, as was proposed in a rotary engine known as Sadler's; the water or other fluid used by me being, as hereinbefore stated, employed in its heated state, and for a purpose altogether different from that of condensation."

For an Improved Oil Can, for oiling the rubbing Parts of Machinery. —*Eliphalet S. Scripture.*—This can is in the form of a funnel, with the spout so small as just to permit the oil to drip out, and the bell mouth is closed up air-tight, by a disc of flexible metal, which is kept out by the tension of a helical spring within, so that when this disc is forced out as far as the flexibility of the metal will permit, the capacity of the can has its fullest extent, and being filled with oil, a slight pressure on the disc tending to force it in will reduce the capacity of the chamber and force the oil out of the small aperture in the spout, the discharge being immediately arrested by removing the pressure from the disk. It should be provided with a spout and stopper for introducing the oil.

For Improvements in Presses.—*Joseph Saxton.*—The patentee says,—"My invention and improvements consist; first, in the use of a flexible or elastic platen, instead of a rigid or inflexible plate of metal as a platen; secondly, in the application of pressure to such flexible or elastic platen by means of a liquid, or aeriferous fluid; and thirdly, in the arrangement of machinery in printing presses, copying presses and lithographic, and zinkographic presses, for the purpose of applying such pressure to such flexible or elastic platen.

"The object and effect of using a flexible or elastic platen with the pressure by means of a liquid or aeriferous fluid is, that the platen is equally pressed or acted upon over its whole surface, and which may therefore be employed in any position, to press upwards, downwards, or sideways.

"The said flexible or elastic platen is to be of the necessary size for the press in which it is to be used, as in the case of the ordinary platen, and is to be a thin plate of brass or other suitable metal, varying in thickness from that of a sheet of foolscap paper to about half an inch, according to the dimensions of the platen, and of the vacant spaces between the columns or pages of types or figures, technically in printing called 'the white.'

*Claim.*—"I do not mean or intend hereby to claim as my improvements or invention any of the parts of the machine or machines, presses, or letter-copying machine herein delineated or described, nor do I intend or mean to limit myself to the employment of any particular material or materials in the construction thereof, but to use any which are fit and proper for the purpose intended. But I do hereby claim the use and application of a flexible or elastic platen, in the manner herein described, the application of pressure thereto in printing presses, copying presses, lithographic presses, and zincographic presses, by means of a liquid or aeriferous fluid, in the manner also herein described, and the arrangement of the machinery or parts of the said presses, as herein described, for the purpose of applying such pressure of a liquid or aeriferous fluid to such flexible or elastic platen."

FOR AN IMPROVEMENT IN THE DRIP CUP OF LAMPS.—*E. Whelan.*—The patentee says,—"My improvement is applicable and is intended to be applied to solar lamps which have high, conical chimneys or burners, say of twelve inches, more or less. In lamps of this description, it is difficult to regulate the height and intensity of the flame by simply raising or lowering the wick; and this difficulty I have obviated by so constructing the drip cup as to regulate, with great precision, the supply of air to the interior of the wick. For this purpose, I make the upper part of my drip cup in two pieces, one of which shall swivel or revolve, to a limited extent, on the other, in the manner of circular registers for regulating the draught in stoves, or the admission of heated air into apartments. In each of these pieces there is a series of similar holes, set around in a circle, which may be made to coincide when a full supply of air is to be admitted, and may be closed to any extent required for regulating the draught, there being a check pin, or stop, to prevent said openings from being entirely closed, as a small portion of air is to be admitted under all circumstances."

FOR AN IMPROVEMENT IN PROPELLING BOATS.—*Garrett Erkson.*—Instead of the common paddle-wheels now used in propelling boats, the patentee proposes to use two elliptical wheels, flat or convex, put on the shaft with their longitudinal axes at an angle of about 45 degrees with the line of the shaft.

FOR IMPROVEMENTS IN THE MANUFACTURE OF BOATS AND OTHER VESSELS OF SHEET METAL.—*Joseph Francis.*—The patentee says,—"My invention consists in forming the sheets of metal with mouldings or beads in suitable places to take up the surplus metal, when the said plates are pressed into form, by means of projections on the die and corresponding depressions on the matrix, or concave mould, which gather up the metal and prevent wrinkles around between the upper and lower parts of the boat, so as to present a smooth surface, and also in forming a recess or bed for the gunwale, which holds it in place and prevents its getting knocked down. I also add a flanch around the stem and stern-posts, and along the line of the keel, which takes up the surplus metal there and forms the keel and stem and stern-posts."

## LIST OF PATENTS GRANTED FOR SCOTLAND FROM THE 22ND OF MARCH, TO THE 9TH OF APRIL, 1846.—(CONTINUED FROM PAGE 236.)

Benjamin Fothergill, of Manchester, Lancaster, machine maker, for improvements in certain parts of machinery used in the preparation for spinning, and in the spinning and doubling of cotton wool, and other fibrous substances. April 9.

John Robert Johnson, of Alfred-place, Blackfriars, Surrey, chemist, for improvements in purifying gas, and in the treatment of products of gas works. April 9.

Reuben Goodale Fairbanks, of Cecil-street, Middlesex, civil engineer, for improvements in machinery, or apparatus, for making, moulding, or manufacturing bricks, tiles, and other articles from earthy or plastic materials. (Being a communication from abroad.) April 13.

Alexander Alliott, of Lenton, Nottingham, for certain improvements in the rotary machines employed for drying and other purposes requiring the application of centrifugal force. April 14.

John Ainslie, of Alperton, Middlesex, brick and tile manufacturer, for certain improvements in the arrangements for the manufacture of bricks, tiles, and other similar articles from clay and other plastic substances, and in machinery or apparatus for the manufacture of bricks. April 14.

James Laming, of Mark-lane, London, merchant, for improvements in making the cyanides, and ferro-cyanides of potassium and sodium. (Being a communication from abroad.) April 15.

James Allingham, of Dublin, Ireland, gent., and James William M'Gaulay, Dublin, aforesaid, clerk, for certain improvements in steam engines. April 16.

John Lake, of Apsley, Hertford, civil engineer, for certain improvements in propelling. April 16.

Samuel Heseltine, jun., of Bromley, Middlesex, civil engineer, for improvements in machinery, or apparatus for dressing stones for grinding corn, grain, and other substances. (Being a communication from abroad.) April 17.

William Mather, of Salford, near Manchester, Lancaster, and Colin Mather, of the same place, millwrights and engineers, for improvements in metallic pistons. April 21.

Edward Auguste Désiré Guichard, of Rue des Jenueurs, Paris, France, for improvements in printing calico and other fabrics. April 21.

Extension of Bennet Woodcroft's patent to six years, for certain improvements in the construction and adaptation of a revolving spiral paddle for propelling boats and other vessels in water. April 21.

*Movement of the Atmosphere.*—It has been found by long-continued anemometric observation, that the atmosphere in our latitude is moving constantly northward at the rate of about ten miles an hour.

*Cornish Silk.*—At the last Annual Meeting of the Royal Cornwall Polytechnic Society scarves were shown, which had been manufactured in Spitalfields from the produce of between 700 and 800 worms kept in an attic room in Truro. In size and weight the worms rather surpassed those in Italy; the cocoons were larger; the quality of the silk, when reeled, was fully equal to the best imported, and the quantity exceeded the Italian average; and this in a season not remarkably propitious.

*The Oregon Steamer* lately launched at New York (intended, we believe, to run between that city and Liverpool) is stated in the American papers to have run from Allen's Point to the foot of Fulton-street, New York, a distance of 130 miles "in 5 hours and 43 minutes," being at the rate of nearly 23 miles an hour. If there be no exaggeration in the case, this may be well called "the quickest trip on record." The *Oregon* is a vessel of 1,000 tons burden, and [illegible]0 horses-power; 330 feet long by (only) 35 [illegible]; cylinders, 72 inch, stroke 11 feet. She is fitted up in a style of such extraordinary splendour that the cabin furniture and appointments are stated to have cost 30,000*l.*, which is rather more than that of the boat herself and engines!

*Carpet Weaving:*—Mr. Biglow, an American artisan, is stated to have invented a power loom for weaving ingrain carpets, which is already in use by the Lowell Company, who have set fifty looms in motion, and expended nearly one hundred thousand dollars in this branch of manufacture. The carpets are represented as of the finest quality.

*An Iron Skew Bridge.*—A very bold and ingenious specimen of a skew bridge is now erecting on the line of the North British Railway, at the south foot of the Calton-hill, Edinburgh. It consists of six strong beams of cast iron, each composed of four or five pieces joined with rivets, and cast in the form of an arch. They are about 80 feet long; the roadway from wall to wall is 26 feet broad, and has a narrow foot-path on each side, at the outer edge of which cast iron columns are placed, supporting the beams at 10 or 12 feet from either extremity. The beams rest on their ends on solid masonry, and fastened to each other by strong wrought-iron bars running across them at right angles. The angle of the skew—assuming the clear space, from wall to wall, along the beam to be 74, which we believe is very near the truth, and the actual breadth of the road and foot-path being 26 feet—it follows that the obliquity, or the angle of the skew, is 20 degrees.

*Prescribing by Telegraph.*—The *Lockport* (U. S.) *Daily Courier* says,—"Early in the forenoon of yesterday a gentleman stepped into the *Telegraph* office at Buffalo, and desired to have Dr. Stevens, who resides in this village, called into the office, as he wished to have some conversation with him. The doctor was summoned, when the gentleman at Buffalo said his wife was ill, and desired Dr. Stevens to prescribe for her. The physician obtained a full and accurate statement of the patient's symptoms and condition, and then telegraphed his prescription. It is presumed the patient did well, as the local journal stated the doctor was to have been consulted again in the afternoon if the morning's prescriptions were not effectual."

*Evaporation of Water under Electrical Insulation.*—M. Rowles suspended two similar capsules of eight and a half inches diameter by silk strings, over a stove that was heated daily. Into each vessel eight and a half ounces of water was poured; one of the vessels communicated with the earth by a copper wire. At the end of twenty-four hours, 2 oz. 279 grs. had evaporated from the insulated capsule, and 3 oz. 144 grs. from the other, making a difference of 345 grs. in favour of the capsule in communication with the earth. The same result was obtained with the heat of the sun.

*Printing in Colours.*—Mr. Adams of Philadelphia is stated to have invented a machine by which any variety of colours are printed at one impression. The plan is somewhat like that of the ruling machine. The ink fountain is divided into sections, capable of enlargement or diminution, or variety of arrangement at pleasure.

*Atlantic Steam Navigation.*—Mr. Collins, an extensive owner of New York packet-ships, has proposed to Congress to build five ships, of 2,000 tons each, and 1,000 horses-power, exceeding in speed and strength any that ever sailed, to carry the United States mail between New York and Liverpool, for 385,000 dollars a year.

*The Steam Hammer.*—The largest and most powerful steam-hammer which Mr. J. Nasmyth has as yet constructed is one erected at Sir John Guest's Iron-works at Dowlais. The hammer, or block of cast-iron, which gives the blow to the iron on the anvil, is upwards of six tons weight, with a clear fall of seven feet perpendicular. The force of the blow which this gives out is tremendous indeed, but is under such control as to be made to drive a nail into soft wood, with a succession of the most delicate taps. The perfect control under which this gigantic machine is placed will be understood by practical iron manufacturers, when we state that it treats a puddled ball in the most kindly manner, until it is brought into a compact cubical form, when a few masterly blows give final and effectual "notice to quit," to every partical of cinder or scoria that may be lurking in its most inner recesses. The immediate purpose for which Sir J. Guest has erected this monster steam-hammer is to give some six or eight tremendous blows to each of the piles or blooms, from which railway bars are rolled, so as to thoroughly weld them into one solid mass ere they go to the rolls, to be extended into the finished rail. These rail blooms are 3 ft. 9 in. to 4 feet long, and about 10 in. square; and as the hammer-face is 3 ft. 9 in. long, by 2 ft. wide, it covers every part of the surface of the bloom at each blow. It is a remarkable sight to see the effect of these massive blows in expressing every article of cinder from the bloom. The most marked improvement in the aspect and quality of the rail was perceptible in those which had been subjected to the action of this gigantic, but most docile, hammer. It is most reasonable to expect that the superior quality thus conferred on the iron, and the thorough welding of all the separate bars, of which it is piled in the bloom, will in the most important degree enhance the quality and durability of the rail so produced. The anvil of this monster steam-hammer is supposed to be the largest casting in the world—being no less than 36 tons in one solid mass. This important invention is now making rapid progress in regard to its adoption by iron manufacturers all over Europe and America.—*Mining Journal.*

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☞ INTENDING PATENTEES *may be supplied gratis with Instructions by application (post paid) to Messrs. J. C. Robertson and Co.*

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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

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## THE MAN-LIFTING ENGINE ERECTED AT UNITED MINES, GWENNAP. BY CAPTAIN W. FRANCIS.

Fig. 1.

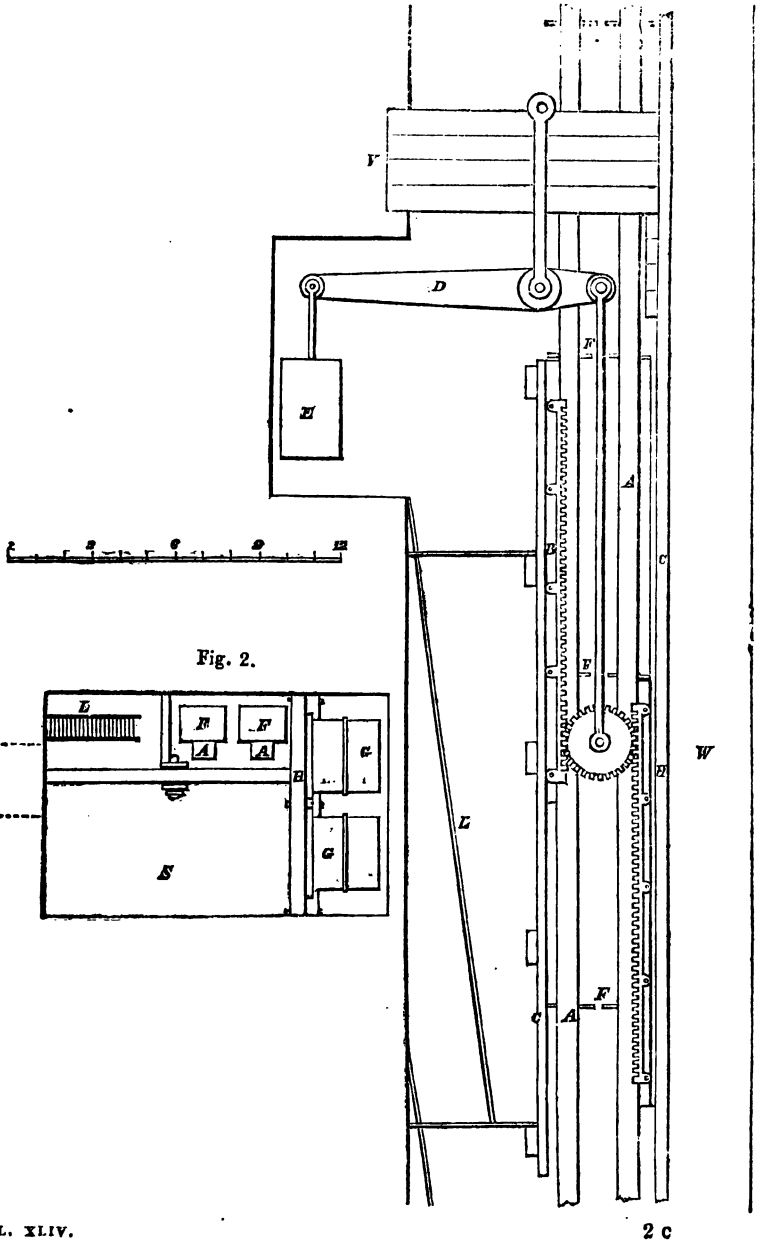
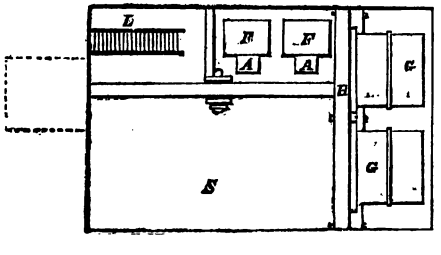



Fig. 2.



## DESCRIPTION OF THE MAN-LIFTING ENGINE ERECTED AT UNITED MINES, GWENNAP.

BY CAPTAIN W. FRANCIS.

[From the Transactions of the Royal Cornwall Polytechnic Society for 1845.]

In the early part of June last, the second machine, which has as yet been erected in Cornwall, for lowering and raising the miners, was brought into action at the United Mines, in the parish of Gwennap.

The principle adopted in the construction of this machinery, is the same as that on which the machine at Tresavean mine had previously been constructed, and which may shortly be stated to consist of wood rods, having a reciprocating motion, with platforms attached to them, on which the men stand, simply, and step from the platform on one rod to that on the other, at every turn of the stroke which the rods make, and the arrangements in both are very similar. The only differences of any importance, consist in the engine at the United Mines being placed at a distance of about forty fathoms from the shaft, instead of being near to it, as at Tresavean; and the rods at the former place being balanced underground by what are termed balance levers, instead of balance bobs; a further description of which will be given hereafter.

The engine employed is a 32-inch cylinder, double acting, 6 feet stroke, equal beam. Besides giving motion to the machinery for lowering and raising the miners, it crushes nearly the whole of the ores which the mines produce; and it also works two lifts of pumps, which are required in sinking the shaft below the 170 fathom level. These various purposes to which it is applied, require that it should be always at work, instead of being worked only at stated periods of the day, as is the case with the engine at Tresavean mine.

The wheels on the crank-shaft are, each, 2 ft. 4 ins. diameter; and they drive two others of 14 feet diameter, each; consequently, six strokes of the engine are required to make one revolution of the large wheels. To one of the arms of each of the large wheels, the horizontal rods are attached at a distance of 6 feet from the centre, thus making the length of the stroke 12 feet.

The shaft to which the machinery is applied, is a large one; being 12 feet long, by 8 feet wide at one end, and 7 at the other.

The narrow end of the shaft, for 4 feet in length, is divided from the other part by boarding, and is used for drawing stuff through. Of the remaining space, a part 8 feet in length by 2 feet 6 inches in width, is appropriated to the rods and platforms of the Man-Machinery, and a ladder road, which has been provided for the men to resort to, in the event of an accident to the machinery. The space occupied by the rods and platforms alone, is 4 feet 6 inches long, by 2 feet 6 inches wide, which is found to afford sufficient room for them. That part of the shaft which remains unappropriated for the present, is 8 feet in length, by about 5 feet in width, and is reserved for pump work, should it be necessary hereafter to erect an engine on this shaft for drawing water.

The wood rods, used for lowering and raising the men, are 7½ inches square for the first 60 fathoms below the surface, 7 inches square for the next 100 fathoms, and 6½ inches square for the remaining 50 fathoms, making together 210 fathoms—the depth to which the machinery is now applied; but this will be increased as the shaft is made deeper, which is now being done.

The distance from centre to centre of the rods is 2 feet; and the size of the platforms, on which the men stand, is 18 inches long by 15 inches wide; the latter are so fixed on the rods as to have a space of 6 inches between them, at the time the men step from one to the other.

The length of the stroke being 12 feet, the platforms are, consequently, fixed at that distance from each other, on each rod.

The weight of the rod is balanced, partly by counter weight on the back end of each of the bobs, at the surface, and partly by means of three balanced levers underground; one of which is at the adit level, one at the forty-five fathom level, and the third at the one hundred and twelve fathom level. The manner of applying these levers may be best shown by the accompanying engravings. The letters A A represent the two rods; at the back of each rod a tooth rack of 14 feet in length is bolted on. A pinion wheel suspended by side links from the end of the lever, works in the racks, and revolves as the rods make their stroke without varying its position up or down more than a few inches. The lever is suspended from timber placed in the shaft for that purpose: at the back end of it there is a box hung, which holds a ton of ballast; and as the length from the point of suspension to the box, is four times greater than that to the end of the lever from which the wheel is suspended, it follows that a portion of the weight of the rods equal to four tons, is thus counter-balanced.

The great object gained by the use of levers, instead of balance bobs, is a considerable saving of expense, as the ground which is required to be excavated for them,

and the materials of which they are made, are both very much less than would be necessary for bobs. At the same time it must be admitted that a greater amount of friction is caused by the levers than by balance bobs, arising from the wheels of the former having a tendency to throw the rods asunder, and thereby causing them to press against the stays by which they are kept in their position.

The loss of power thus sustained has not been very nicely ascertained, but it is believed not to be very considerable; care, however, in the application of these balance levers is requisite to prevent friction, which otherwise may be so much as to overcome the benefit to be derived from the economy of their construction.

Fig. 1 is a sectional elevation of the machinery. Fig. 2 a cross section.

A A the main rods; B, racks; C, wood backs against the racks; D, balance lever; E, balance box; F, sollars of platforms; G, kibbles; H, partition; L, ladder; S, engine shaft; V, wood carrier; W, whim shaft.

The relief afforded to the miners by this machinery can scarcely be estimated, and can only be fully appreciated by those, who, after having nearly their whole strength and spirits exhausted by working for eight hours, and even longer in some instances, in an atmosphere varying in temperature from 95° to 105° Fahrenheit, had formerly to climb to the surface by ladders. The amount of physical suffering which it alleviates, is almost incalculable; and this benefit would, of itself, be full compensation for the outlay incurred in its erection; but the advantages, in a pecuniary point of view, which it affords, are equally striking, and will be very apparent by the following statement:—

The number of men now being lowered and raised by this machinery, is about 450; and of boys, 50; making together 500 persons. The average depth to which they are sent is 200 fathoms, which requires between sixteen and seventeen minutes, and, of course, the same time is required to bring them up, making together thirty-four minutes for the descent and ascent, whilst by ladders it would be full sixty-five minutes; thus showing a saving in time of a half-hour per day, or in round numbers, 150 hours in the year; which should be valued at four pence per hour, and which would amount, on

| | | | |
|---|---|---|---|
| Four hundred & fifty men, to | £1125 | 0 | 0 |
| Fifty boys at two-pence per hour for the same number of hours, will amount to | 62 | 10 | 0 |
| | £1187 | 10 | 0 |

| | | | |
|---|---|---|---|
| It has been already stated, that the engine is applied to other purposes than that of working the man-machinery. A careful dissection of the expense of working it has been made, by which it is shown that the charges on account of working the machinery in question, do not exceed £30 per month, or (per annum) | £1187 | 10 | 0 |
| | 360 | 0 | 0 |
| | £827 | 10 | 0 |

Thus it appears that a saving of upwards of 800*l.* per annum is effected, without including in the estimate anything more than the mere difference in time, which is gained by the machinery. It is difficult to calculate correctly the increased amount of labour derived from these 500 persons on other grounds; but it may be easily conceived, that, as the labour of coming to the surface is now almost superseded, much of the strength which was before required to bring them up by ladders, is now expended in their work.

The cost of the machinery, and the erection of it, exclusive of the engine, which had been provided before, was somewhat less than 2000*l.*; it will, therefore, be repaid within two and a half years. The cost of erecting an engine of sufficient power for working the machinery would be about 1000*l.*; but in all cases where the engine can be applied to other purposes, it may be done with advantage, by making it powerful enough to accomplish the additional work which it would be required to perform.

The construction of the machinery in question has been under the charge of Messrs. Hocking and Loam, the engineers of the United Mines; and is after the principle invented and submitted to the county by the latter, through the medium of the Polytechnic Society, some years ago.

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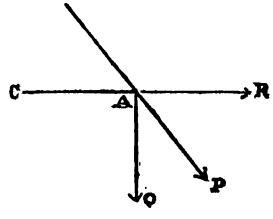
At the last exhibition of the Cornwall Polytechnic Society there was a plan, proposed by Mr. H. Huthnance, of Hayle, for introducing the Man-engine in those mines in which there was no single shaft that went to the bottom. In this plan, the power was transferred by means of iron pipes filled with water, placed vertically in each shaft, and lying along the level between them. Plunger poles, in each vertical part of the pipe, received and transmitted the motion.

THE "DISCOVERIES IN MECHANICS."—"E. A." IN REPLY TO PROFESSOR WOOLHOUSE.

Sir,—I have to thank Mr. Woolhouse for his remarks, and as he has not leisure to elucidate this subject, which is without doubt very perplexing to those who have not thought long and patiently about it, I will offer a few observations, by which I hope not only to convince Mr. Woolhouse that I do not labour under any "misconception of the mechanical principles of constrained motion," but I venture also to trust that this discussion may serve to clear up the ideas of some of your non-mathematical readers on this highly important subject.

I stated at the conclusion of my last that I had no doubt of the applicability of "virtual velocities" in the crank, as well as all other possible machines; therefore, I admit at once, that if the pressure in the piston-rod be multiplied by the velocity, at any one instant, of the piston-rod, this product will always, and of necessity, be equal to the pressure acting perpendicular to the crank-arm multiplied by its velocity. It is not in this sense, then, that any "power is lost," and I certainly have to apologize to Mr. Woolhouse for not adverting to the fact that this was all he meant to prove in his Tract. Perhaps Mr. Russell may mean no more, in which case "I have sinned against" him also, and beg leave therefore to exculpate him from this second discovery. But the "strains"—both that *in* the crank, and that tending to break the piston-rod across, not merely exist, but are *absolutely necessary* in order that the foregoing statement may hold good. If, for instance, the piston-rod were at perfect liberty to move in obedience to the "cross-tug" of the connecting-rod, then we could not have the force P sec. $\theta$. This force, as Mr. W. rightly observes, is the result, *not* of the force P in the piston-rod *alone*, but of that and the re-action of the collar through which it moves. Now the motion of the piston-rod is *perpendicular* to this latter strain, and therefore, if we were to take it into account in estimating the virtual velocities, (which I think Mr. Woolhouse would have done well, perhaps, to state,) its virtual velocity being zero, we throw it out of consideration altogether. Similarly, since the end of the crank-arm moves in a circle, and therefore at right-angles to the arm, whatever may be the amount of strain in it, *it produces no velocity in its own direction; i.e.* in other words, its virtual velocity is nothing. Thus, then, the two strains are properly left out in the calculation—that is, so far as the establishing the principle of virtual velocities in this case is concerned. To show the *necessity* of their existence—let the reader suppose that the crank-arm, for example, is not perfectly rigid, but capable of being *stretched out* by the action of the connecting-rod. Suppose CA, the crank-arm, revolving round C, and P the pressure in the connecting-rod; resolve this into R and Q, the former acting *in* the crank-arm and *stretching it out*, the other perpendicular to it.




In this case the joint A, instead of travelling wholly in the direction AQ, (the only direction in which it can produce any *useful* effect,) would partly travel in the direction AR, and this last exertion would be just so much effect *lost*. In fact, *its velocity in the direction* AQ (*i.e.* in its proper circle) would be so much diminished, and therefore the proposition, as stated at the commencement of this paper, would no longer be true. The principle of virtual velocities would hold the same as ever, but we should have a term R× (velocity in direction of R) and this would be *lost* so far as the power of the crank is concerned.

Practical men may therefore rest assured (and by similar considerations to those now used, always satisfy themselves) that when every part of a machine is *rigid*, the power exerted at one point is always faithfully represented at every other, either in the form of *pressure* or *velocity*. But if the parts are not all perfectly *rigid*—if there is any *giving way*, there *may* and generally *will* be a loss in the *useful* effect. For example, in rowing a boat, as the water

*slips* away from the oar, just so much of the *useful* reaction is lost. The same in paddle-wheels and the screw-propeller. But the principle of virtual velocities holds just the same as ever; only, there is this great *practical* difference — in *rigid* machines all the moving points are moving in a *useful* direction, either directly or indirectly; but in those which are not rigid, some of the points may be moving in directions utterly *useless*.

It does not follow, therefore, that whenever the principle of virtual velocities holds, there is no *loss of useful* effect; and this is one point which induced me to trouble you with my last communication. Mr. Russell talks very largely of "setting out from the grand fundamental principle of virtual velocities," as if it would prove that there is no loss of useful effect in *every possible* kind of motion; and as this might be misunderstood by practical men, I have thought it would be not amiss to make these observations. The principle holds *universally*,—the *inference*, viz., that no useful effect is lost, holds only in those machines where *every* part is perfectly rigid. Mr. Woolhouse will therefore perceive that all I meant by "loss of power" was merely intended to point out the *detrimental* effect of the strains in question. One of these, in fact, is continually tending to snap the piston-rod and to make it work loose, permitting the steam to escape: the other is endeavouring to loosen the axis from its bearings. As the machine is constituted, however, these strains are *essential to the production of the full useful effect*; and my only objection to Mr. W.'s investigation arose from their not being distinctly *recognised*, and shown to be of no consequence, in the application of the principle. He may retort on me and say that "none but clumsy mathematicians" would require this information; but I should remind him that his tract is professedly written for the instruction of such. With regard to Mr. Russell, Mr. Woolhouse has justly criticised his want of logical accuracy, and therefore I need say nothing. Yours respectfully,

E. A.

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MISCELLANEA MATHEMATICA.—NO. XII.

(Continued from page 342.)

*Geometry studied as a rational science.*

The two classes of propositions which occur in works of geometry generally, are sufficiently well marked in their characters to create no difficulty in discriminating them at a glance. The *problem* was, however, the earliest class of proposition, and originated in those *wants* of mankind, which required some particular processes to be performed: and the *theorem* would first take its rise from special observations upon relative positions of the lines employed in the construction of a problem; and would, in fact, be a mere induction, such as we have in a former number of this series stated to be the ordinary mental habit of practical draughtsmen. That the Greeks obtained some crude notions of practical geometry from the Egyptians seems to be admitted on all hands, and Sir J. Gardner Wilkinson has insisted, somewhat strenuously, that the Egyptians possessed a profound knowledge of rational geometry. How far the worthy knight is himself competent to decide in an inquiry like this, is, however, a question that should be settled beforehand; and even if his own knowledge be admitted, (which it is not,) there would still be wanting other proofs than the *scrawls* which he found in the catacombs and ruins, to show that the age of the Pharaohs was in geometry anything less empirical than the practical geometry of our own day. The subtile and analysing mind of the Greek appears to be the only one of ancient times that could grasp the abstract conception of space, and the principles which govern demonstration. Thus would arise, and thus did arise, the second form of proposition, the *theorem*, in its complete state as we now possess it. Our knowledge of the properties of figured space is more extensive than that of Euclid—especially as regards space of three dimensions—but our mode of investigating those properties, is not in any single particular superior to, or even different from, that which was employed in the school of Plato. Of course we are not here speaking of the application of algebra to geometrical investigation: but even were we to take this into consideration, (which we shall do hereafter,) it is very questionable whether, in reference to the class of readers to whom we especially address ourselves, the algebraic mode of investigation be not, *in practice*, inferior to the geometrical. At any rate, the discovery of the one pervading principle of geometrical demonstration is the parent of all

the practical and theoretical knowledge of our times; and such is the law imposed upon the human mind by HIM who created it, that by no other means than this shall any man acquire a niche in the historic pantheon of geometrical discovery—or even become capable of efficiently and safely using the discoveries of others.

It is remarkable that the form of the proposition which was the latest discovered is the simplest in its character. The *theorem* alleges, that *if* certain geometrical magnitudes exist under specified relations, *then* a certain other specified relation will also inevitably and universally exist amongst those magnitudes.* The existing magnitudes and relations constitute the "hypothesis of the theorem;" and the stated consequence of the hypothesis is variously termed the "affirmation," "property," or "conclusion."

When the demonstration comes to be required, the general process is similar to that described in our last number: but there are classes of properties that do not admit of the *direct* application of the theorems and axioms, which can be brought to bear upon the proof, without at least greatly extending the number and complexity of the axioms, so as even to risk contradictions amongst them. The difficulty is avoided by proving, that whilst the hypothesis is such as to impose *some relation* between the magnitudes under consideration, that relation *can be no other than that which is affirmed in the proposition*. The demonstration then proceeds to assume that a relation different from that which has been assigned, exists; and taking this as a truth, contemporaneously with the hypothesis, a series of inevitable consequences are deduced, till we arrive at a final one which admits of comparison with some part of the hypothesis. If that final conclusion be incompatible with the hypothesis, the assumption which led to it must be erroneous; and hence it is erroneous to suppose the proposition itself to be other than true—or shaping the conclusion a little differently, it follows that the theorem, as enunciated, is true.

Euclid's first use of this method is in book i. prop. 4; where the absurdity to which the contrary conclusion is reduced is, that two straight lines would inclose a space if the proposition were not universally and inevitably true. We meet with it again in props. 6, 7, 8, 11 (*cor.*), 14, 19, 25, 26, 27, and 29; whilst from the second book it is entirely absent. In the third it reappears in props. 1, 2, 4, 5, 6, 9, 10, 11, 12, 13, 16, 18, 19, 23, 27; whilst in the fourth again, not a trace of it is found. The peculiarly happy and refined definition of proportional magnitudes in the fifth book enables Euclid generally to construct his argument in a direct form: but still where it becomes necessary to use the indirect mode of demonstration, he makes no scruple about doing so,—as is evinced by his 9th proposition of that book. The sixth book, too, is almost free from the *reductio ad absurdum*; but in the eleventh and twelfth, especially the former, it is found to be very freely used. In all cases, however, it is only employed of necessity—never from choice; and it will be apparent upon looking over the subjects of the propositions where it does occur, that this necessity mainly exists for the establishment of the earlier and simpler properties of figures, and becomes unnecessary in the more advanced and recondite series of propositions. Thus, in the first book, it is used to establish the elementary properties of triangles and parallels; in the third, the elementary properties of circles; and in the eleventh, the elementary properties of intersecting lines and planes subjected to assigned hypotheses.

The contemplation of a very few of Euclid's demonstrations which are effected by this method, will render their character perfectly clear, and enable us to dispense with further remarks on the subject.

With regard to the *problem*, it will be seen that to merely devise a construction is not enough; we must know that the proposed construction does accurately fulfil the assigned conditions. In certain simple cases it requires little skill beyond the application of the common notions that grow up with us in the present state of society, to perceive *how* the construction may be effected. In such cases, however, these theorems themselves (or common notions) are admitted and classed in our minds as facts; and we seldom proceed further in the matter than to *imagine* that we see the proof of the process as we go

* This is the most frequent form: but it sometimes occurs that the affirmation takes the form of denying that a specified relation can ever exist amongst them.

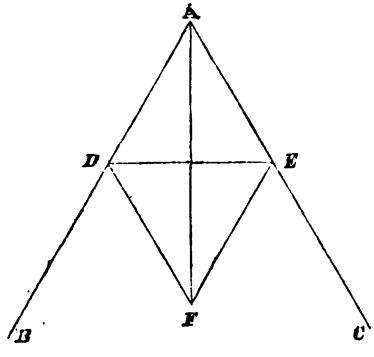
along. When, however, the problem is more operose and founded on principles more recondite, this resource fails us, and we are compelled either to become mere copyists of the process, or to possess a considerable number of properties of the figure in question, in order to devise the construction which is required. The ordinary constructions of Euclid are not very complex, neither are those which are usually given as exercises; and hence no specific contrivance would be necessary to assist the invention of a well-trained mind, in the present supposed stage of a student's reading. The Greeks had, however, invented a mode of *analysis* by which great facility was conferred upon the investigation of methods for constructing intricate and difficult problems. As we shall probably devote one of our papers to this subject hereafter, we shall defer further remark on the method till then.

When the construction has been effected, the matter will stand thus:—

The *data* (the things given from which to construct) and the lines, etc. introduced by the actual construction, are to be viewed as the *hypothesis of a theorem;* and the resulting figure, with its relations, as *the truths affirmed in that theorem.*

The "demonstration" of the truth of the construction then becomes identical with the demonstration of the theorem so enunciated.

Let us take for instance, Euc. i. 9. We here see that after the construction has been performed, we have to prove the following theorem:—




If in two lines, AB, AC, which meet in A, two points D and E, equally distant from A be taken, one in each line; and that if on DE an equilateral triangle DFE be constructed, and AF drawn, then AF will bisect the angle BAC.

Although the intervening operations between the data and the final thing required (*quæsitum*) may be ever so numerous, this is still the state of the proposition at which we enter upon the demonstration.

It will very often happen both with the theorem and with the problem when transformed by the addition of its construction to the state of a theorem, that other lines or circles besides those actually existing in the hypothesis (or in the data and construction of the problem) will be required to facilitate the demonstration, and in not a few cases they become *essential.* The choice of these is subject to no rule, nor can any suggestions capable of general applications be offered. In this will often be shown the skill of the geometer as strikingly as in any part of his processes. We see it manifested often in Euclid's Elements—as for instance in i. 5 and 48, in iii. 37, and in iv. 10; but it is in more complex propositions that this kind of invention is most displayed. Every process of this nature should, however, be carefully stored up in the mind of the student; and he will find innumerable fine specimens of it in those older English periodicals which have been principally devoted to geometry.

Were we addressing those whose sole object in the study of geometry was intellectual exercise, we should strenuously urge upon them a considerable portion of *independent practice,* both in construction and demonstration; but upon the readers whom we actually and professedly address, we are bound to urge the same course still more strenuously. As well might a painter expect to become eminent from *only looking* at pictures, as a geometer to become capable of independent inquiry by merely reading and studying what others have done. Many collections of exercises, adapted to the student's purpose in a greater or less degree, have been published; but they are not in general so arranged as to afford him convenient practice cotemporaneously with his study of Euclid's text. The edition of Euclid by Mr. Potts, which we reviewed a short time

ago, appears to us well fitted, by its judicious arrangement of the exercises, for this purpose. The reader will thus gain facility in research, accurate habits, and extended knowledge, at the same time. We would warn him, however, against the habit of "peeping into Bland or Cresswell for a hint" on the subject; and urge him to confine himself to his Euclid and the treasured results of his own investigations in all cases. Let him, too, not content himself with merely performing any given problem or demonstrating any given theorem; but rather keep his mind awake to the uses which may be made of the problem, or the other properties that may belong to his figure besides the one which has been enunciated in his theorem. It is this habit of close attention to *all* the properties of a figure, and to their systematic deduction one after another, that constitutes the inventive geometer, and gives such immense power in the application of mathematical science to practical purposes.

We have one remark more to make in connection with this subject. Euclid's geometry was essentially theoretical—the development of geometrical facts, not the construction of geometrical problems. Every problem that was solved was one subsidiary to the constructive part of the demonstration of a theorem, such as we have alluded to in a recent paragraph; and it was only so introduced in order to justify every step of the demonstrative process. If we look at the problems of Euclid merely as practical processes, they are often inferior to others, given by subsequent writers who have had an immediately practical purpose in view. At the same time the great mass of our writers on practical geometry have satisfied themselves with merely copying Euclid's constructions, and adding a few others which the demands of the mere draughtsman rendered imperative. A good and really complete work on practical geometry remains to be written,—one in which the most extended and the most refined geometrical research shall be brought to bear on the solution of graphic problems; and one at the same time, in which every construction shall be attended by its rigorous demonstration, however recondite may be the principles on which it is founded. As an illustration of what we mean we shall refer to the chapter of geometrical problems in the 12th edition of Hutton, given by Professor Davies, where it will be seen that the problem is constructed irrespective of the place which its demonstration occupies in the range of theoretical geometry. That chapter, however, has upon its face the marks of hasty composition, and the consequent want of symmetry and completeness, which we could wish had been given to it. Still it is the only work with which we are acquainted, that in any degree approaches to our own view of what such a work should be; and as the author of that chapter has of late years devotedly attached himself to the geometry of engineering, it is much to be desired that he would himself finish the work which he has there begun, and give us such a complete system of practical geometry as should meet our real wants—at the same time, attaching to each proposition and to each mode of construction its appropriate demonstration. We have no wish to see a series of mere processes, however valuable, obtruded upon the profession, unless accompanied with undeniable demonstrations of the validity of the processes. We have heard, indeed, that Mr. Davies is now employed upon a work on *Descriptive Geometry*, in which a practical bearing is to be kept in view throughout; and we have no fear of the accuracy of its principles being frittered away in his hands to meet the prevailing taste of our country and our day. He is too well known as a rigid disciplinarian in pure geometry to create anxiety on this head. Our main fear is the want of sufficient support from the public to encourage him to go to press. Even, however, should this support be withheld, we are sure that such a work on plane geometry as we have pointed out, would be encouraged.

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### BURSILL'S IMPROVED CUTTING PLIERS.

Sir,—Should the following juvenile attempt to improve the common cutting pliers, rewarded at the last distribution of prizes at the Society of Arts, be considered worthy your notice, I shall feel obliged by your inserting it in your highly useful journal.

Having had frequent occasion to use cutting pliers, I have experienced great inconvenience from a defect in their construction; for no sooner have the cutters

Fig. 1.

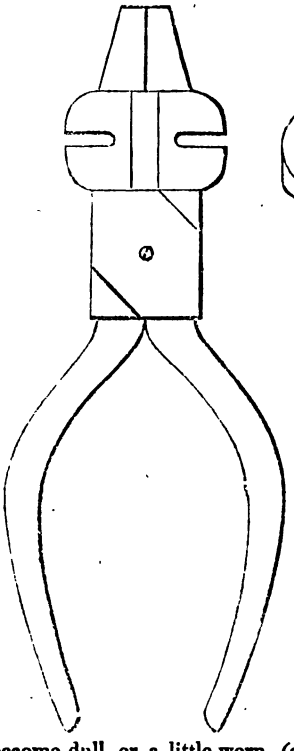

Fig. 2.

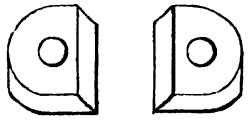

Fig. 4.

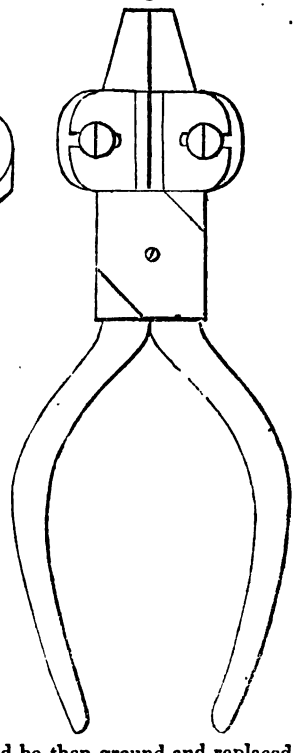

Fig. 3.

become dull, or a little worn, (and these parts are especially liable to wear,) than any attempt to restore them by grinding, results in their being seriously injured, if not destroyed altogether. Frequently the cutters will no longer come together by reason of the nips; and to file out the teeth, and afterwards fresh cut and harden them is a troublesome operation.

To overcome this difficulty, I make use of a pair of moveable cutters, which, should they at any time become notched, can be taken out with the aid of a screw driver, and be then ground and replaced in a very few minutes, when the pliers will be as good as a new pair.

Fig. 1 represents a view of the pliers previously to affixing to them the moveable cutters; fig. 2, the moveable cutters; fig. 3, the screws; fig. 4, the improved pliers with cutters attached complete.

I am, Sir, your obedient servant,

W. BURSILL, JUNIOR.

Osnaburgh-street, Regent's-park,
May 24, 1846.

## FORD'S OMNIBUS VENTILATOR.

[Registered under the Act for Protection of Articles of Utility. W. Ford, of Brixton, Surrey, Proprietor.]

Fig. 1.

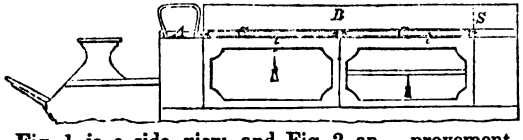


Fig. 2.

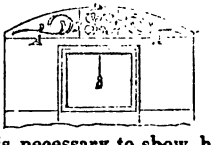

Fig. 1 is a side view, and Fig. 2 an end view of so much of an omnibus furnished with this much-needed improvement, as is necessary to show how it is accomplished. A is an inner roof, and B an outer roof, placed above A.

Between the two are side ports or apertures, *cc*, provided with shutters, *tt*, turning upon pivots in their ends. In the interval between the roofs, as shown by the dotted lines *s s*, is a square trunk or ventilator, without any bottom, which is perforated at the sides to admit air from the shutters, *tt*, into the body of the carriage; the end-piece between the roof is also perforated, as shown in fig. 2. The shutters are closed or opened by small cords for that purpose inside the omnibus. The health and comfort of all who are accustomed to travel by omnibuses, would be much promoted by the adoption of this judicious modification in their construction.

## FURTHER REMARKS ON NEUTRAL SERIES, IN REPLY TO MR. COCKLE.

Sir,—At page 347 of this Magazine I find some additional observations by Mr. Cockle, in reference to the theory of neutral series; and one or two queries on the subject are addressed to myself, with a view, no doubt, to the removal of all misgivings as to the soundness of the principles on which that theory is based. In replying to these queries I shall use as much brevity as is consistent with that respectful attention which everything from Mr. Cockle's pen must always claim.

"Is there any inconsistency in supposing that

$$1 - 1 + \&c. \pm 1 \mp \tfrac{1}{2} = \tfrac{1}{2};$$

and that

$$1 - 1 + \&c. \textit{ in inf.} = \tfrac{1}{2}?"$$

My answer to this would be—*Yes*. And if any one were to maintain the contrary, I think I should proceed with him as follows. I should remind him that the $\frac{1}{2}$ which is appended to the first series is fixed and unalterable in *value*, though not in *sign*; that it is altogether independent of the number of terms comprehended under the "&c.," and that, in virtue of this independence, the $\frac{1}{2}$ could never be modified, much less destroyed, however many terms he might choose to introduce into the gap marked by the "&c." And, if this be admitted, does it not follow, I would ask, that though the number of these interposed terms be conceived to be infinitely great, the $\frac{1}{2}$ being *always* independent of the number of terms, continues independent even up to this extreme case, and is as necessary as in every preceding case, to justify the above equation? So long as the interposed terms are finite in number, the whole row of terms to which the $\frac{1}{2}$ is appended consists of a finite number, which is thus exclusively odd or exclusively even; but when the number of terms is infinite this restriction no longer exists; it gives place to an ambiguity, since the *whole number* $\infty$ has as much claim to be considered even as odd, and odd as even. Hence the only way in which the $\frac{1}{2}$ can be affected by the hypotheses of a finite or an infinite number of terms preceding it, is by its taking a determinate sign in the former case, and an ambiguous one in the latter. The $\frac{1}{2}$ itself is throughout, and whatever be the hypothesis as to the number of terms in the neutral series—strictly *constant*.

The second of the preceding series, therefore, is incorrect, the constant $\frac{1}{2}$ being suppressed. Introducing this with its proper ambiguous sign, we have, as already laid down,

$$1 - 1 + \&c. \textit{ in inf.} \mp \tfrac{1}{2} = \tfrac{1}{2}$$

$$\therefore 1 - 1 + \&c. \textit{ in inf.} = 1 \text{ or } 0.$$

Calling the sum of the infinite neutral series S "have we any right to make any other supposition than that $1 - S = S$, and consequently that $S = \frac{1}{2}$?" I think it will be perceived that this supposition is unwarrantable, as also the results in the very valuable "Report" referred to in Mr. Cockle's paper, *except* when those results are exclusively restricted to convergent series. In the neutral series, $S = 1 - 1 + 1 - 1 + \&c.$, it is impossible that $1 - S$ can be equal to S, however great the number of terms may be; for whenever the S on the left is *odd* as to number of terms, that on the right will be *even*, and *vice versâ*. In other words, when the one S is 1, the other will be 0; the two, therefore, cannot be added together and expressed by 2 S. Whether the terms of the series $1 - 1 + 1 - 1 + \&c.$ be finite or infinite in number, there can be no question that if the leading term be removed the remaining series will differ from the original by the value of that term; we cannot, therefore, without error, represent both series by the same symbol S. It is plain that $n$ terms will always differ from $n + 1$ by a unit.

The case however is very different as respects the *converging* series.

$$1-(1-\tfrac{1}{\infty})+(1-\tfrac{1}{\infty})^2-(1-\tfrac{1}{\infty})^3+\&c.,\ \textit{in inf.}$$

As briefly noticed in my former paper (page 287,) and more fully in the *Philosophical Magazine*, (vol. xxvii. p. 363,) the zero $\frac{1}{\infty}$ becomes effective only when coming into combination with infinite exponents: the effect of this combination, as shown in the place last referred to, is to render the infinitely remote terms of this series zero: we may thus consider the two following forms as identical, viz.:

$$1-(1-\tfrac{1}{\infty})+(1-\tfrac{1}{\infty})^2-(1-\tfrac{1}{\infty})^3+\&c.,\ \textit{in inf.},$$

$$\text{and } (1-\tfrac{1}{\infty})-(1-\tfrac{1}{\infty})^2+(1-\tfrac{1}{\infty})^3-\&c.,\ \textit{in inf.};$$

for although it is here implied, that in the first series the exponents extend to $\infty'$, and in the second to $\infty'+1$; yet, as in both cases the terms to which these exponents belong are zero, the difference between the two is only apparent. Each series, indifferently, may therefore be represented by S; so that here we really have the equation $1-S=S$, and consequently, $S=\frac{1}{2}$. In the strictly neutral series, before considered, the term at the distance $\infty$, differs from that at the distance $\infty'+1$ by the number 2; in the present series these terms are alike zero; and it is only because of this that the equation $1-S=S$ has place.*

I shall feel gratified if these explanations prove satisfactory to so rigid and scrupulous a reasoner as Mr. Cockle. To some of your readers the subject may appear trivial and undeserving of so much of your space, but to those who perceive the bearing of it upon the general theory of definite integrals, this space will not be considered as misappropriated. The investigations of the continental analysts—of Poisson especially—will be found to be very materially affected by the principles developed in these enquiries respecting neutral series. Another interesting and long-disputed question has also become settled by aid of these principles: I mean the rules of Leibnitz and Bernoulli, for the summation of certain series that have been called neutral, and of which a satisfactory proof has, I think, been given in the *Philosophical Magazine* for December last. The views and reasonings which I have entered upon in this latter publication were opposed by Mr. Moon, of Cambridge, in a tone and spirit that precluded all controversy on my part: but if that gentleman should see the additional remarks on the subject in these pages, and which Mr. Cockle's papers have invited, and should still feel disposed to controvert the principles I have advanced in opposition to his own, which seem to me to be erroneous, I shall be happy, with your permission, to discuss the subject with him in this Journal: stipulating, of course, that such discussion be carried on with that sobriety of temper which should always characterise scientific enquiry, and which can scarce fail to be employed where *truth* is the only object to be attained.

I am, Sir, your obedient servant,

J. R. Young.

Holywood, near Belfast, May 16, 1846.

P.S. In my former paper the following type errors occur. The series marked (2) should be (3), and the preceding series (2). In the last line but one of the foot note, *know*, should be *knew*; and the inverted commas at p. 288 should be omitted.

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ACCOUNT OF SOME FURTHER EXPERIMENTS IN SCREW PROPELLING.

Sir,—In your last volume, page 391-2, there appeared a letter of mine, describing the result of an experiment in screw propelling, and a suggestion of a new system for the same; but that experiment was merely on a model scale; and now I beg to bring to the notice of your readers another experiment which I made with a full-sized screw propeller.

In my former communication I proposed to enclose a screw propeller in a

* It may be remarked here, that although I object to the suppression of the leading term in the neutral series, yet I have myself done the same thing in the convergent series above. It must, however, be observed, that *my* suppression merely amounts to changing 1 into $1-\frac{1}{\infty}$, which differs from 1 by no numerical value. The constant ratio is preserved the same.

tube, which should be laid along the keel, running from stem to stern, inside of the vessel, and the ends of which should pass through the hull for the water to run through it. Being fully persuaded that a screw propeller thus fitted would have the same power of propulsion as if it were placed in free water, I was desirous to try its effect, and accordingly I constructed a screw of two feet in length with four blades, twelve inches deep, and two feet spiral, forming a complete screw in itself. I enclosed it in a wooden tube six feet in length and thirty inches in diameter. I fitted the apparatus to the stern of a good-sized pleasure boat, which was kindly lent to me for the occasion. The motion was communicated to the screw by a suitable disposition of cog-wheels, and worked by hand labour. Four men could work it very easily on the first shaft which multiplied the screw four times to one. This gave us but a slow speed; but still it was in proportion to the velocity of the screw. Then we tried to apply the motion to the second shaft, which mutiplied the velocity of the screw sixteen times to one; but then, although six men were applied on it, they could not obtain the half of the speed which the four men could obtain from the first shaft, because the resistance was too great for the limited power. If, however, we had had room enough in the part of the boat where the motion was placed, to apply twelve or fifteen men on it, we should have obtained the desired speed. Although, therefore, the experiment was not attended with the full speed anticipated, it nevertheless proved successful, so far as the limited power applied on it would allow, and also considering the unfavourable circumstances which attended it.

As to the friction of the water passing through the tube, I had in my experiment a double disadvantage; for the friction was greater on the outer surface of the tube than on the inner, on account of the various obstacles the water had to meet with from the thickness of the hoops round the tube and its fittings; and yet, notwithstanding all these unfavourable circumstances, if we had had a sufficient power upon the screw we should have obtained a fair speed.

Perhaps it may not be improper to mention that the blades of my screw are in one piece, each without joints; that its weight is 30 lb., and that by the peculiarity of its construction a screw of 50 or 100 feet long could be made with the blades in one piece each without joints. I consider this to be very important in a screw propeller on the system I propose. Conjointly with this advantage I should mention another which is not less important, and which is connected in particular with the originality of its construction, namely, its lightness. Suppose a screw propeller of 100 feet long, with four blades twelve inches deep and two feet spiral, were to be made according to the usual mode of screw construction, what would be its weight? Why, very probably 15 or 20 tons!! Such a weight would utterly preclude the attainment of any great velocity by such means. I feel all the force of this difficulty in calculating how I might best carry my system of propelling into effect, and to obviate it I had recourse to a method I believe entirely new, and which answers very well indeed. Thus, if a screw of two feet in length, and in the same proportion as the one I propose, weighs only 30 lb., a screw of 100 feet in length would weigh 1,500 lb.; but admitting that the shaft, on account of its great length, should be increased proportionally in weight, the whole would not exceed one ton in weight; for I have also provided to construct the shaft on a light system and quite efficient in strength. Thus, a screw of the length and weight as above stated could be made to revolve with a very great velocity and with much less power and at less expense than if it were of an immense weight; consequently the tear and wear of machinery would be less.

While on the subject, allow me, sir, to point out another great advantage which is connected with the enclosing of the screw propeller in a tube. In the way in which screw propellers are commonly fitted to vessels, when the ship has a favourable wind so as to render the assistance of the screw useless, the screw must be drawn out of the water, because it would impede the progress of the ship under sails. This must always be a very great objection on account of the enormous weight of the screw and its awkward position, which must render the operation difficult and

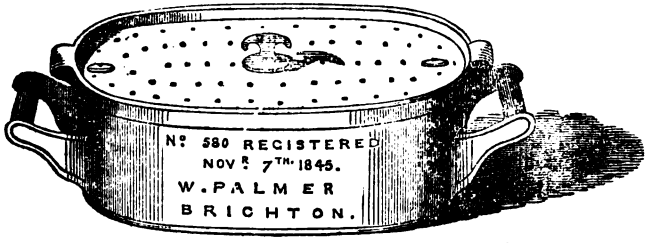
dangerous. In the system I propose this objection is entirely removed, for when the ship is under sail and with wind so as not to require the assistance of the screw, the fore end of the tube may be closed by a stopper suitably placed to render the operation of closing and opening prompt and easy. As the water could no longer enter the tube the screw could no longer interfere with the progress of the ship, and as soon as the wind became contrary, the tube could be immediately opened, and the screw simultaneously put into motion in the same instant without any disturbance to the machinery or loss of time. With many apologies for having so far trespassed on your valuable space,

I am, sir, your obedient servant,

L. GACHET.

Coggeshall, Essex, April 19, 1846.

PALMER'S BRIGHTON HAND SHOWER-BATH.




Morning ablutions, in one shape or other, are now considered by medical men as among the greatest promoters of health. Hitherto cleanliness has been thought to be the sole object of daily washing, but at length we are assured by medical men that washing of the hands and face is but of secondary importance, unless the whole skin be washed and rubbed well at first rising. Whole books have been written to prove how essential free perspiration is to the health and how necessary a clean skin is to a free perspiration. The skin is like a cullender, and is pierced with innumerable holes through which the worn-out and useless elements of the body exude and are got rid of, when they would otherwise be pernicious. For this purpose many people use a large sponge, which they moisten with water, then rub the body all over with it, and afterwards with a towel. Some people use shower-baths, which cannot be brought into common use, because of their expense and size. A few years ago a hand shower-bath was invented, made like a sugar loaf, with a cullender at the bottom and a handle at the top with a small hole, which was stopped with the finger while raised above the head, and on the removal of the finger the water fell. This was very inconvenient, from the height to which it was necessary to lift the hand.

Mr. Palmer has succeeded in overcoming all the inconveniences of former contrivances, and has invented a hand shower-bath which may be of any size, from half a gallon upwards. It is of an oval shape, the size of a pie dish, and has a handle at each end; the top is pierced with holes, of which two are larger than the rest, and lead to two pipes, which lead nearly to the bottom, and are easily covered with the two thumbs when lifted over the head and turned upside down, when the thumbs being removed, the water descends. The person stands in a tub or pan, to receive the water. He has then only to rub himself well with a towel.

This invention is cheap, light, durable, and cannot get out of order. It has been examined and approved of by the most eminent medical men in Brighton.

R.

STATISTICS OF STEAM ENGINES IN CORNWALL—REPLY OF CAPTAIN GEORGE W. HUGHES (U. S. E.) TO PROFESSOR POLE.

Sir,—My attention has just been directed to a communication from Mr. Pole, which appeared in the May Number of your Magazine for the year 1845, in which he complains that I have done him injustice in relation to the authorship of a short article on the Cornish Steam Engine, reprinted in your January

Number of the same year, from the Franklin Institute Journal—an American periodical.

Mr. Pole says, "Captain Hughes promised to acknowledge this assistance; had he done so, he was very welcome to make any use he pleased of it without notice from me; but as he has thought proper (in Pennsylvanian fashion) to *repudiate* the source from whence he drew it, it is but fair that I should make known the part I took in the matter."

The article in question is a mere extract from a report by me to the Secretary of War, printed by order of the Senate, "On the working of Copper Ores," in which the performances of the Cornish steam engine are briefly and incidentally discussed. On the very first page of that report, and in the most conspicuous manner, I have acknowledged my obligations to several gentlemen to whom I was indebted, either for information or for the means of procuring it; and I particularly mentioned Mr. Robert Were Fox, Mr. John Taylor, (the eminent mining engineer,) and Mr. Pole. In reference to the latter, I say—"My examinations were prosecuted in company with my friend Mr. Pole, civil engineer, of London, who has kindly permitted me to *incorporate* his notes on the Cornish steam engine with my own." Having Mr. Pole's permission, (as he admits in his note to you,) I felt myself at liberty to make what use of his manuscript I pleased; and freely availed myself of it accordingly—often when we treated of the same subject, employing his language, with slight alteration, instead of my own, which my public acknowledgment to him fairly implies.

I was not aware, till a few days since, that the extract relating to the steam engine had been republished separately from the main body of the report. If I had known it, I would certainly have taken care that Mr. Pole should have received full credit for it.

I can account for Mr. Pole's dissatisfaction on no other ground than on the supposition that he had not seen the whole paper, (in which my indebtedness to him is more fully admitted,) although I sent him a printed copy of it, as soon as it was published, together with other pamphlets, through a bookseller of London. The package, in all probability, did not reach its destination. Under this charitable view of the subject, I do not feel disposed to complain of Mr. Pole's course; yet, at the same time, in consideration of the kindly relation formerly existing between us, I cannot but regret, that in seeking to do himself justice, (as he doubtless believed,) he should have indulged in the use of offensive language.

May I ask of you the favour to give this note an early insertion in your Magazine? And oblige your obedient servant,

GEORGE W. HUGHES.

Washington, April 7, 1846.

## THE "BLASCO GARAY"—OSCILLATING STEAM ENGINES.

The *Blasco Garay*, which is the vessel to which we alluded three weeks ago as being in the course of being fitted by Messrs. Miller, Ravenhill, and Co., with the largest pair of oscillating engines ever yet constructed, namely of 350 horses power, made her first experimental trip down the river on the 14th inst. The following are the exact dimensions of the vessel and machinery:—

| | ft. | in. |
|---|---|---|
| Length between the perpendiculars | 187 | |
| —— over all ..... | 209 | |
| Breadth between the paddle-boxes | 31 | 11 |
| Depth of hold ..... | 20 | |
| Mean depth with machinery on board ..... | 10 | 6 |
| Diameter of cylinders ..... | 0 | 68 |
| Length of stroke ..... | 6 | |

The ease and equability with which the cylinders, notwithstanding their great size, vibrated on their trunnions, was a matter of gratifying surprise to all who witnessed their performances. Time was, when the most skilled engineers deemed that some 40 or 50 horses power was the utmost extent to which this system of construction could be carried; and certain it is that it is only by workmanship of a very high degree of excellence that so extraordinary an advance can have been made. The speed producible by the engines was tried only in going down the river, when both wind and tide were against the vessel; but she went, notwithstanding, at the rate of a knot in 7 minutes 1 second, being equal to 9·9 statute miles per hour.

Emboldened by their success in this instance, Messrs. Miller and Co. have undertaken to construct for the Oriental Steam Company three pairs of oscillating engines, on the same plan, but of still larger dimensions. The cylinders are to be of 76 inches diameter, and the length of stroke 7 feet.

SCREW PROPELLING.—"MORE FACTS," BUT IN FAVOUR OF THE SCREW.

The well-known iron screw vessel *Waterlily*, of 184 tons, and 50 horses power, left Blackwall, on Wednesday, the 13th instant,—the same day on which so many casualties occurred to the craft accompanying the fleet from Spithead, in consequence of the tempestuous state of the weather,—at 2¼ A.M., and arrived at Portsmouth at 5¾ P.M., having performed the voyage in exactly sixteen hours, which is a shorter period, we believe, than the same voyage has ever been performed before, either by paddle-wheel or screw-vessels. The weather was very heavy and squally throughout, and there was a great deal of head sea; yet the *Lily screwed* her onward way notwithstanding, as steadily as if she had been in smooth water, and under the most favouring gales. When the small proportion of horse-power to tonnage (being less than 1 to 3½) is taken into account, the performance of the vessel on this occasion cannot but be considered as a most extraordinary feat in steam navigation. When she made the same voyage on two former occasions, the times, as recorded in the *Mech. Mag.* of the 12th and 19th of July last were, 17 hours 11 minutes, and 16 hours 49 minutes. In every instance in which the *Lily* has been out, whether in good or bad weather, she has proved herself an admirable sea-boat, and certainly has done much to remove the *Hoseasonish* prejudices which exist in certain old-school circles to the use of the screw as a propeller. KAPPA.

H.M.S. "FAIRY."

Sir,—Permit me to correct an error made, I am sure unintentionally, by Captain Hoseason in his remarks on screw propelling in your Magazine of last week. The gallant officer states that one of the boilers of the *Fairy* burst. This is not the fact; the boiler in question was damaged by being allowed to "salt," by which the plates of the fire-places were burned, and consequently leakage took place, and which prevented the further use of the boiler in question. No bursting or anything of the sort took place. Your insertion of this in your forthcoming Number will oblige, sir,

Your obedient servant,
JOHN PENN.

Greenwich, May 18, 1846.

THE SEPTENARY SYSTEM.

After merely opening the letter which Mr. Jopling addressed to us late last week, we had recorded a promise, which, upon a more careful perusal of it, we cannot in justice to our readers perform. In the shape of a reply to "Centurion"—whose objections to the want of practical usefulness in the "Septenary System" it utterly fails in meeting—it consists mainly of a multitude of hypothetical assumptions and fishing interrogatories, the discussing and answering of which might by remote possibility bring out something to the advantage of the "system," but which would also, and much more certainly, occupy a space in our pages, which we should be universally blamed for devoting to any subject of so purely speculative, if not visionary a character.

We have given Mr. Jopling every chance of bringing his "system" before the world; and if he has failed to impress the minds of his professional brethren with his own ideas of its value, it is no fault of ours. That he has so failed is now unquestionable. Neither will we conceal that our own impressions of it are now far less favourable than they originally were; or rather to speak the whole truth, turned quite the other way. We think it no shame to own that we have felt ourselves wholly unable to resist the force of the arguments urged by "Centurion" against it. We may observe, by the way, in reference to this gentleman, that he has been at the trouble to investigate the equations of the curves produced by two of Mr. Jopling's mechanical combinations, and has submitted them to us. We cannot consistently with the resolution to which we have come to terminate the "Septenary System" discussion, lay this investigation or any part of it before our readers; but we may state for the information of Mr. Jopling, that the result of it is, (to use "Centurion's" own words,) that "the characters of the curves are such as to preclude all possibility of bringing them into use, when the physical properties of matter are taken into account; and that, when used for merely ornamental purposes, the properties of the curves are not of the least moment."

Let us add, that "Centurion" is a gentleman known to all the mathematical world for his familiarity with analytical geometry, and that a better authority on such a subject as this does not probably exist.

As long as we thought there was any prospect of the Septenary System leading to some beneficial practical results, we considered it our duty to afford Mr. Jopling every assistance in developing it. Many an ingenious contrivance has been allowed to sink into oblivion from the want of such fostering encouragement as we have ever felt great pleasure in affording to inventors. At the same time that we are well aware that many inventions must inevitably end in failure, we lay no claim to any power of

discriminating, *à priori*, between those that will succeed and those which must fail, excepting always such as violate some familiar and established law of nature. All others must be left open for discussion, till they are either proved to be useful or illusory. On this principle we have acted with respect to Mr. Jopling and his system.

We cannot close this notice without a reference to a letter which we have received, signed "W. F. W." The writer says, "I took what was considered a tolerably good honour at Cambridge, and there we never heard of Mr. Jopling and his system, and it was not many years ago either." This is evidently intended to imply that every practical invention of any value is made a subject of general study by the undergraduates; and that anything which is not matter of familiar knowledge in every hall and every college, cannot possess the least possible merit! We do not measure inventions by such a standard; and we believe, too, that few Cambridge men, besides this writer, will propose such a criterion of the value of any mechanical—or even, let us add, *mathematical*—invention. Is, we would ask "W. F. W.," Horner's method of continuous approximation heard of in Cambridge even yet? Are Chasles's beautiful systems of geometrical investigation transplanted to his *alma mater?* Or, are there three men in the whole University who are familiar with the descriptive geometry which has been a subject of uniform study in all the great continental schools for half a century?

We urge not these things as a reproach to Cambridge, for with the existing arrangements of the University it would probably not be easy to introduce more subjects into the *curriculum* than already form parts of it; but we do urge it as a reproach for any man to hold up the studies of the University as comprising everything that is valuable in the practice of architecture and engineering, whilst whole and very extensive branches of even mathematical science do not find a place there. Neither can we view it as any disparagement to Mr. Jopling that "his name and his system" are unknown at Cambridge. Our discontinuance of his papers arises from a very different cause—a cause already assigned.

ED. M. M.

## NOTES AND NOTCIES.

*Size and Age of Trees.*—The traveller Adamson discovered in India a baobab tree to which the largest oaks would be mere saplings, and the stem of which measured from 80 to 120 or 130 feet in girth. As they could not cut a tree down every time they wished to ascertain its age, they measured it, and thus formed an approximate guess. They thus came to the conclusion that baobabs existed for five thousand years. The celebrated cypress of Mexico was at least as old, if not older still than these. It must be remarked that the deluge did not destroy the trees, since the dove brought to Noah a branch of a living olive tree. Records still exist in the library at Milan, by which it was ascertained that a cypress which grows in that city was in existence in the time of Julius Cæsar. Now that tree was only twenty-six feet in circumference, while the Mexican cypress was 120 feet. There was nothing in the constitution of trees at present existing to prevent their living on to the end of time, whether measured by hundreds or by thousands of years. The lecturer then exhibited a section of the largest branch of a yew tree which grew at Forthampton, Gloucestershire. It was nine inches in diameter, yet 227 perfect and distinct rings could be counted in it. Decandolle, from an examination of a number of yew trees, ascertained that the average amount of its growth laterally was three-twelfths of an inch in the year. The circumference of the whole tree was twenty-seven feet; and hence its age would be 1360 years. This landed us in the time of the Saxons; and the lecturer had no doubt that there were yews still in existence which began to grow long before the Romans marched across our island. At Fortingall, a village among the Grampians in Scotland, there was a yew tree the age of which would be more than 2500 years. It was evident that, as the vitality exists in the *liber*, the tree could go on constantly pushing forth its fresh rings of wood, when the centre was dead: the vital principle was still working, and it seemed as if it could go on for ever.—*Lecture by Mr. Lees, on Forest Trees.*

*Theory and Practice.*—Professor Mapes, of New York, made mention in one of his recent lectures of a newly invented steam-engine which was to drive a boat to Albany by a very little expenditure of hydrogen. The steam was to be passed through a cylinder containing red-hot iron clippings, which would absorb the oxygen and allow the hydrogen to pass on to the piston. This plausible theory was subjected to the test of a mathematical estimate—when it was discovered that not all the navies in the world could carry iron enough to absorb sufficient oxygen to provide hydrogen for propelling a boat to Albany.

*Immense Steam Factory.*—The central part of the Portsmouth (American) steam factory, which is 204 feet long, is now two-thirds up. The centre part is to be six stories high, the wings five stories. Height of the lower story 13 feet, of the other stories 12 feet. The length of the front will be 504 feet, or about a tenth of a mile. There will be about four acres of flooring in the factory. Number of spindles, 50,000; number of operatives, 1200 to 1500. In the rear, two parallel buildings, two stories high, will be extended 100 feet back from the junction of the main building with the wings; and between those buildings, 50 feet from the main structure, the boiler-house is to be erected. The foundation of the chimney, which is to be 140 feet high, is laid, and is in progress of erection. A gentleman who has been travelling the last year in pursuit of information respecting manufacturing establishments, and who has visited more than a thousand factories, informs us that the largest factory building he has seen or heard of is at Manchester in this State, which is 440 feet in length. There is no factory in England to compare with it for size.—*American Paper.*

☞ INTENDING PATENTEES *may be supplied* gratis *with Instructions by application (post paid) to Messrs. J. C. Robertson and Co.*

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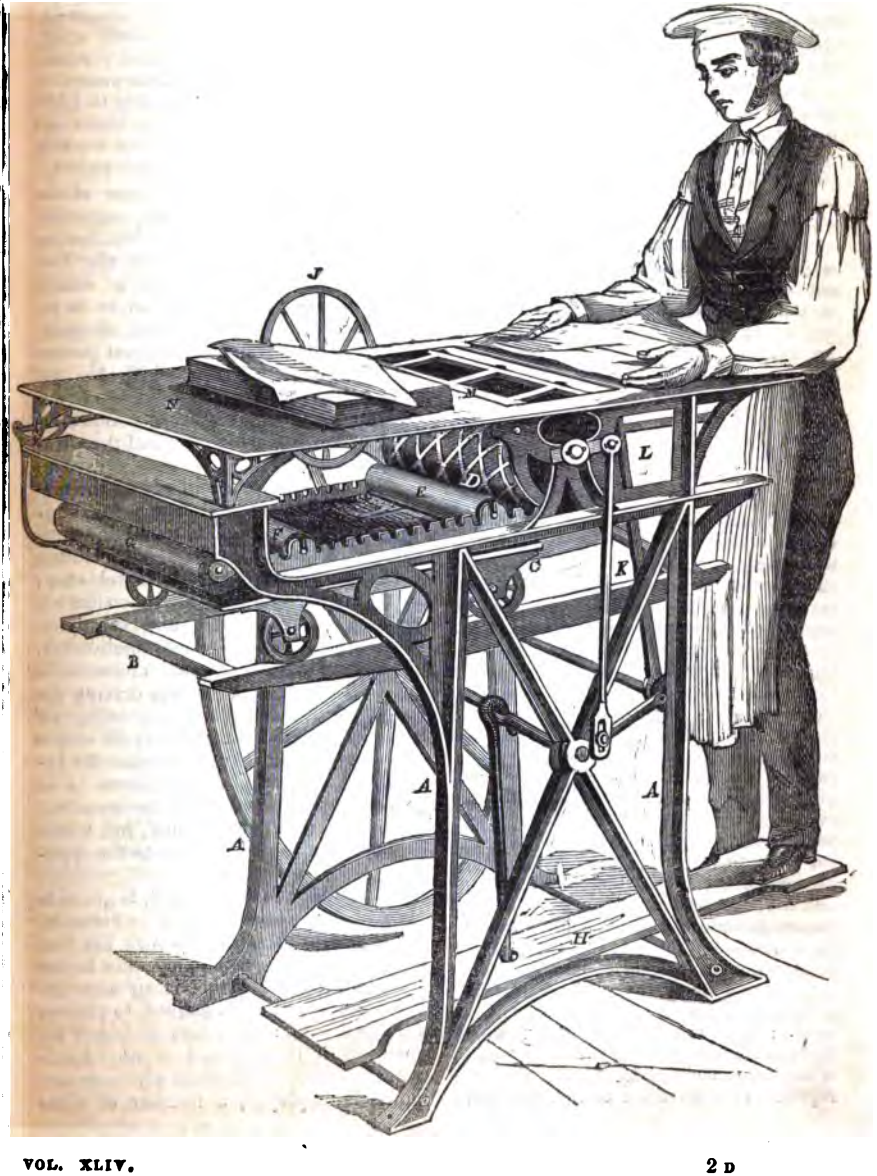
# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1190.] SATURDAY, MAY 30, 1846. [Price 6*d*.

Edited by J. C. Robertson, No. 166, Fleet-street. Double No.


## HILL'S PATENT PRINTING PRESS.



## HILL'S PATENT PRINTING PRESS.

[Patentee Mr. R. J. Hill, 28, Upper Stamford-street. Patent dated August 2, 1844; Specification enrolled September 2, 1845.]

THE *Times*, which is so high an authority in most things, and especially in all that regards that great instrument of its power—the printing press—the improvement of which has been always naturally an object of first concern with its proprietors, and of which they have been by far the most efficient promoters in modern times (for it is to the patronage of Printing-house-square that we owe the application of steam-power to this branch of mechanical art) recently startled the typographical world (through all its *chapters*) by the following announcement:—

"*Hill's Printing Press.*

"This is a very ingenious invention, by which, by means of hand labour, and without the aid of steam power, a hand printer is enabled to produce impressions with a rapidity far beyond anything that the hand-press, or any press not worked by steam, has hitherto produced. The hand-presses hitherto in use have done comparatively very little to expedite the printing and multiplying of copies, and the hand printer has not progressed much beyond the state in which he was placed at a very early period of the art of printing. Those who have made printing, and the machinery by which it is worked, their study, affirm, that although within comparatively few years more than thirty patents have been taken out to secure inventions connected with the machinery of presses, and to enable hand printers to increase the celerity of the process, they are still, as far as speed is concerned, no nearer to the attainment of the object than they would have been had the old German press still continued in use. For though in the construction and mechanism, and the materials employed in hand presses, many very great improvements have been made, and many important facilities secured to the workmen, yet, in point of quickness in producing the work required, very little, if anything, has been effected, and the slowness of production has become the more observable from the extraordinary rapidity with which the steam-press multiplies copies. The small printer cannot, of course, use the steam-press; the machinery, from its bulk, complexity, and great expense, is beyond his means; any invention, therefore, which tends to facilitate and expedite his labours, is important, and worthy of his inquiry and regard. This invention of Mr. Hill is to be seen at his residence; and to those interested in such subjects the inspection of it will afford both profit and pleasure. The dimensions of this machine, though it can multiply copies in the *ratio of four to one over the hand-presses in general use*, do not exceed those of the common press. Its simplicity of construction is also a great advantage, for it has neither tooth wheel, rack, or pinions for giving motion; neither has it the tapes for conveying the paper. A strong lad can work off from 1,200 to 1,500 impressions per hour with less labour and exertion than is required by the common hand-presses to work off 300 impressions."

We think the merits of some of the hand-presses now in use are somewhat underrated in this extract; but having ourselves seen and examined the new press of Mr. Hill we heartily concur in all that the *Times* has said in its individual praise. It is beyond all question at once the simplest and most powerful machine of its class which has yet appeared. On the front page of our present Number we give a perspective view of the one which we had the pleasure of inspecting.

A A are the side-standards of the machine; B B horizontal frame for support of type-table; C C type-table running on wheels or rollers; D, printing cylinder, revolving on horizontal axis; E E, inking rollers; F, distributing rollers; G, ink trough and supplying roller; H, treadle for foot motion; I, fly-wheel for rendering the motion uniform; J, grooved wheel for driving the machine; K K, lever for throwing off the printed sheets; L, receiver for sheets when printed; M, register plate for receiving or "laying on" the sheets to be printed; N, part of top of the machine, forming a table when in use, but which is turned up to afford access to the type-table.

Motion, it will be observed, is given to the machine by means of a treadle, which the pressman works with his foot whilst his hands are employed in laying on the sheets; but this is an arrangement intended to be confined to presses for small work: in presses of larger dimensions it is proposed to use hand-wheels. In establishments where steam-power is employed, a number of these

presses might be driven by an over-head shaft, with very little power and perfect convenience.

Originality cannot of course be claimed, and is not claimed, either for producing the impressions by cylindrical pressure, or for the mode of working the cylinders, in both of which respects Mr. Hill's press differs in little, if anything, from the (now) common steam-press. The chief novelties in this press we conceive to be these; *first*, the peculiar arrangement for moving the type-table; and *second*, the apparatus for taking off the sheets when printed. In both of these respects the simplicity of construction and working efficiency of the machine are such as apparently leave nothing more in the shape of improvement to be desired.

The manner in which impressions are taken is as follows:—The form of types being fixed and made ready for printing, and motion being given to the wheel, the pressman connects the motion of the wheel to the axis of the printing cylinder by a sliding clutch; he then lays a sheet on the register-plate, with its front-edge and one of its ends in contact with a guide, and on the printing cylinder arriving at a certain position of its revolution the front edge of the sheet is secured to the cylinder by claws, which carry it round to meet the types and receive the impression. By the time the impression is completed the cylinder has brought the front-edge of the sheet within the claws of the removing arm, which claws then close, and secure the sheet; and simultaneously, beneath, the cylinder claws open and allow the sheet to pass from the cylinder by the removing claws, and to be deposited on a shelf ready for being removed by hand.

On the end of the cylinder spindle outside the frame, there is a crank-arm which pushes back the type-table after an impression has been taken, and on its arriving at its most backward position, the crank-arm quits its connection with the table, and a connection takes place between the end of the printing cylinder and the edge of the type-table, by which means a firm contact takes place between the two surfaces, which produces the forward motion of the tables and types to produce the impression.

The supply and distribution of ink are effected by the table and types running under the inking rollers in the ordinary manner of steam printing machines.

## THE VENTILATION OF THE HOUSES OF PARLIAMENT.—PLENUM *v.* VACUUM.

Sir,—There is a long article in the last Quarterly Review on Dr. Reid's system of ventilation for the Houses of Parliament, wherein extracts from the evidence of Members are given, by which it appears that neither his principles are sound, nor his practice efficient, notwithstanding the years of experiments which he has been allowed to perfect them in, at the expense of the country. The cost too, is to be from £80,000, to £100,000, a sum sufficient to build a palace, or endow an hospital.

Dr. Reid's principle of ventilation, as you are aware, is to create a partial vacuum, by means of a very high chimney, which, acting like a large and powerful cupping-glass, partly exhausts the air from the rooms, and the members' bodies; and thus causes the sudden draughts of cold or hot air, which rushing in to supply the place of that withdrawn, occasions those sudden chills, and heats, so much complained of by the members. A method of ventilation, that of plenum, entirely different in principle and practice to Dr. Reid's, has occurred to me; and, as the subject is attracting some attention, I beg to trouble you with the details, which are so simple that they can be understood without a drawing.

In the cellars, or an outbuilding, I propose to erect an air-chest, containing a large number of pipes, similar to those in a locomotive boiler, the pipes being made of earthenware capable of bearing a temperature of from about 80° to 100°. The chest is to be filled with steam in the winter, and ice, or ice water, in the summer; and from this chest pipes are to be conveyed to the different rooms to be warmed, and ventilated, and to terminate in troughs behind the skirting; the skirting board having been removed, and a finely perforated zink plate substituted for it, at such parts of the room as may be found most desirable. Near the ceiling, opening into the chimney, is to be placed one of Arnott's valves, which, yielding to the slightest increase of pressure, will allow of the escape of the vitiated air. Attached to the air-chest

will be placed a blower to keep a rapid current of air through the pipes into the apartments to be ventilated; and by varying the temperature of the air-chest, any required degree of warmth, or cold, can easily be maintained in the rooms. Two very fine woven wire sieves, or finely perforated zink plates, should be placed across and near each end of the air-chest, so as to detain any soot, dust, or animalculæ in the air, as it passes through the machine; and these should be made to slide in and out, so as to be changed as often as might be found necessary. By this arrangement the apartments would be kept constantly full of fresh air, and of sufficient density to prevent any draught being felt; and valves would be inserted at the exit of the pipes into the rooms, to regulate the quantity of air to be admitted, so as to afford complete ventilation only.

It will be seen, as I have before remarked, that this plan is diametrically opposite to that proposed by Dr. Reid, and does not require any great factory chimney, nor has it anything about it to endanger the stability of the building, as the pipes would be conveyed along the passages. It has also to recommend it, (what would be considered by some no small advantages) economy, simplicity, and efficiency. In large buildings, such as the Houses of Parliament, a small steam-engine would be required to work the blower, as also to supply the air-chest with sufficient steam to create the required temperature; which, in the air-chest, I would recommend should never be raised above 100°, as I prefer a large surface at this temperature, to a lesser surface at a higher. By this arrangement, the air in winter could never be introduced into the rooms above say 80°, and in summer, the ice or iced-water in the air-chest should not be kept lower than about 40° to 50°; so that all sudden and dangerous chills in the apartments would be avoided and an agreeable and equable temperature preserved, both in winter and summer, pure and free from dust; free also from the slightest draught, which, on this principle, would be impossible.

I am, Sir,
Your obedient servant,
I. H.

City Club, May 20, 1846.

## RECENT MATHEMATICAL INVESTIGATIONS ON THE SUBJECT OF EQUATIONS.

Sir,—I venture to trouble you with some remarks, relative to the investigations which I have recently brought to a conclusion in the *Philosophical Magazine*.

They were commenced in the *Mathematician*, and, although originally I could not but suspect the existence of some limits to the validity of the transformations indicated by the analysis which formed the basis of the discussion, yet considerations arising from the subject of pages 300-1 of the first volume of the work last mentioned, induced me to extend those limits further than, (as subsequent inquiries have convinced me,) I was warranted in doing.

A more minute examination of (62) $h$ and (63) $h$, of the page last cited, has disclosed to me the conditions to be kept in view, when we seek to apply the method to the cases in which those equations occur. In those cases, of course, as in every other, the validity of a transformation depends upon the degree of the given equation. I shall not take up your space by attempting a detail, but refer your readers to page 395 of the present volume of the *Philosophical Magazine*, where the leading instances of illusory results are pointed out, or rather, the commencement of the valid ones noted.

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The principal difficulties to be surmounted in the Theory of Equations are those which arise from elevation of degree, the result of elimination. To take a simple case: Let it be required to transform a given equation into another which shall want its third and fourth terms; this can only be done by satisfying a quadratic and a cubic, involving the same unknown quantities, and the result of elimination is an equation of the sixth degree. We are here stopped unless we can, (1,) supposing two unknown quantities only to be employed, succeed in tracing the final equation to a solvible form;—or, employing a greater number

of unknown quantities, and so rendering the problem indeterminate, (2) cause one of the unknown quantities to disappear from the quadratic, and thus leave us only a cubic in that quantity to solve, instead of an equation of the sixth degree; or, (3) preserving the dependence of the quantities in the quadratic, give the quadratic such a form, that the final equation of the sixth degree shall be capable of decomposition into two cubics, and, in fact, present itself in that manner. The methods of which (1) and (2) are the types, have been, or are being, applied with great ability. That of which (3) is an instance, is the one which I have more especially considered.

Now, independently of the theory of symmetric functions, and that of the rational functions of the quantity which represents the general root of any equation, the theory of algebraic equations may be divided into two parts. The first part comprises,—the transformation and solution of general equations of degrees lower than the fifth,—solutions and partial solutions of particular cases of equations of the fifth and higher degrees, —the arithmetical discussion of the (symbolically) complete solutions,—the reduction of the apparently isolated solutions to a common principle by the method of Lagrange, and, in general, by that of symmetrical products. The second division consists of those transformations which, although they do not conduct us to solvible forms, may yet, to use the words of the late Mr. Murphy, "have more value than as mere speculations," and which, at all events, shed a few wan gleams over some regions of the vast and obscure domain of the higher equations.

It is with reference to this latter point of view that attempts at the solution of the higher equations should be regarded. Some years have now elapsed since, imagining the "irreducible case" to be of merely accidental occurrence, and that it arose from a defect of the method given in the introduction to Barlow's Mathematical Tables, I attempted to discover a purely algebraic solution of a cubic which should have no irreducible case; and I can never forget with what undeserved successes, (though of a nature very different to that which I had anticipated,) these efforts of my earliest youth to arrive at that unattainable goal were attended, nor the feelings of delight and wonder, not unmingled with doubts, which those results once caused me, and more particularly with which, in one case, on examining a supposed biquadratic to which my calculations had conducted me, with a view, if I was stopped in the original problem, at least to ascertain the relation of this biquadratic to, and perhaps obtain its solution (supposing the question reversed) by means of the original cubic, I found the former degenerate into a quadratic. In like manner, I am not without a reasonable expectation that, in contemplating the solution of the equation of the fifth degree, led on, perhaps, by a conjecture, or rather a hope that some oversight might, by bare possibility, have crept into the lengthy and complicated Argument of Abel, even after its reconsideration by Sir W. R. Hamilton, some propositions at which I have arrived may be found to throw some additional light, small though it be, on the higher equations. I shall select a more appropriate medium for publishing these results, but I may perhaps be permitted to mention here, that I believe that I am in a condition to prove, "that the analysis mentioned at the commencement of this paper does not become *illusory, per se*, when applied to the annihilation of the *fifth* and *sixth* terms of an equation of a degree as low as the *eighth*." This is only the first of the results to which I allude, and is selected because it is the simplest case; yet, even when they are all presented, perhaps I shall be obliged to plead the impenetrable nature of the ground in excuse for the paucity of the harvest.

Even with a due regard to the advantages which may, possibly, accrue to the second of the above divisions of the theory of equations, I should be sorry to be understood as wishing in the foregoing remarks, to hold up the solution of the equation of the fifth degree as a desirable field for analytical exertion. Highly improbable—not to say impossible—as is the existence of such a solution, the above observations are made with no such view, but merely to show that failure in one respect may, nevertheless, give an equivalent in another, when appropriate means and general principles are employed. But where such means and principles are not used, that deep regret which wasted time and perverted

ingenuity always entail, must follow; and, in speaking of this great problem, which apparent simplicity and insurmountable difficulty conspire to render so dazzling, it may be no unfriendly duty to inform those who, unversed in the higher departments of the theory, would attempt to obtain a solution by means of algebraical artifices, similar to those whose success they are in the habit of witnessing upon ordinary occasions, that their task is hopeless. Their case is not unlike that of the man who attempts the same thing by the rule of three: they would scarcely say that *he* fails,—he simply commits an absurdity.

The failure of general methods, when applied to this particular question, will, however, always be a subject of interest, perhaps of importance, more especially should it be the means of suggesting some method of reducing this problem to an equation whose solution (like that, for instance, of certain equations, involving surd functions of the unknown quantity) shall be *absolutely* impossible. The *classification* of the difficulties which occur in treating of equations is another, not undesirable, object. The first obstacle that we meet with, viz., that to the annihilation of the three middle terms of a biquadratic, is connected with the subject of some admirable remarks by Gergonne at pages 137-9 of t. iii. of the *Annales de Mathematiques*, and also at page 54 of that volume.

In the last paragraph but one, I of course alluded only to algebraic solution, and in no degree to researches, such as those of the late Mr. Horner, which, as I have, ere this, expressed to his zealous friend, Professor Davies, must place the name of their author side by side with that of Vieta on the page of the history of science. The historian, when he takes up his pen to record such investigations, will doubtless give a high and most honourable position to those distinguished men, whose labours have tended to perfect and elucidate the practical methods.

In conclusion, allow me to add, that at page 299 of the first volume of the *Mathematician* (where I was engaged in considering certain transformations expressible in terms of one function) I have overlooked a material simplification of the argument; the equality of all the quantities included under the same sign of summation at the top of the page will be obvious on examining their derivation, so that it is unnecessary to *prove* that equality.

I would also observe with reference to the paper of Professor Young at pages 394-5 of the present volume of your journal, that I have been compelled to defer the formal consideration of the remarks of my learned and respected friend; I have preferred this course to that of giving them, what could only have been, a hasty notice.

I am, Sir, yours, &c.,
JAMES COCKLE.

Devereux-court, May 26, 1846.

## PROFESSOR DAVIES'S "DESCRIPTIVE GEOMETRY."

Sir,—The kind manner in which you have spoken of my writings on several occasions deserves my sincerest thanks, and I beg you to accept my grateful acknowledgment of your friendly notices of my labours.

In your last number of the *Miscellnnea Mathematica* you express a fear lest I should not receive due encouragement to proceed with my work on Descriptive Geometry; and it is solely to remove any such impression from your own mind and that of your readers that I now address you. I am happy to state that no difficulty on that score is likely to intervene, as I am already engaged with an eminent house for the publication on terms satisfactory to myself. The delay arises from a different cause—the difficulty of obtaining sufficiently clear information from practical men as to their real wants in this science, and the peculiar nature of the difficulties which they find in practice.

As to your views on the subject of plane geometry for practical purposes, I have no remark beyond this to make—that I fully agree in your views on the subject; but that I do not contemplate any immediate publication of the character to which you refer. At the same time, to any competent geometer, who may feel disposed to undertake such a work, I shall at all times be happy to render any assistance in my power.

I have the honour to be, Sir,
Your obedient and obliged servant,
T. S. DAVIES.

R. M. A., May 25, 1846.

## OBSERVATIONS AND EXPERIMENTS ON THE CHEMICAL ACTION OF HEAT, PARTICULARLY IN REFERENCE TO DETERMINING WHETHER IT HAS NOT, AT HIGH TEMPERATURES, PER SE, AND INDEPENDENT OF THE AIR, A SLIGHT POWER OF OXYGENATION; WITH INCIDENTAL REMARKS ON THE ATOMIC THEORY, IN REFERENCE TO THIS ACTION.

BY HORATIO PRATER, M.D., PH.D.

*Section First.*

It would appear that, as far as observations have yet gone, we may consider the solar spectrum as composed of three distinct bundles of rays. 1. The deoxygenating, at and a little beyond the violet. 2. The light producing, about the centre of the spectrum. 3. The calorific, at and beyond the red extremity of the spectrum. The object of the following paper is to attempt to trace the chemical action of the calorific rays, and to ascertain whether or not they, in their strongest and most concentrated form (viz., as heat commonly so called) have not *per se*, and independent of the air, a slight oxygenating power,* just as the rays at the opposite end of the spectrum have (as a general principle) a disoxygenating power. That such is the condition of the spectrum (somewhat analogous to the opposite poles of the galvanic battery) will, I think, be made at least probable, if heat arising from ordinary combustibles can be shown to have such a power. The following experiments were therefore all made on heat of this character, since in the spectrum the separation of heat, *of an intense character*, from light must be tedious and difficult or impossible.

Before beginning to relate these experiments it may be observed in favour of heat, *per se*, having a slight power of oxydation, that Van Marum states he burnt very fine gold wire by his battery, not only in air but also in *hydrogen gas, or other gases not capable of supporting combustion*, and that the same purple-coloured oxide was formed alike in all cases.* Anxious after I made the following experiments to see if the opinion to which they led me could be found in any of the older chemical authors, it appeared to me that the opinion was supported by Van Marum's experiments just mentioned, but that Scheele alone directly proposed the theory (rejected latterly even in his own time) that caloric was composed of a certain quantity of oxygen, united with phlogiston, and that light† was a combination of the same with a still greater quantity of phlogiston. "By phlogiston," says Thomson, "Scheele seems to have meant hydrogen." Now if this were really the case, of course I cannot consider the opinion to which the following experiments, as regards heat, seem to lead as having been entertained by Scheele; but as it seems possible that Scheele may have meant nothing more than heat by phlogiston: thus, that heat, in a certain state, contains oxygen, then Scheele may be said to have anticipated in a measure the following views, and accordingly I have thought it right to allude to his hypothesis, however obscure it may be.

It having been rendered clear to me from several experiments that iron and copper filings are oxidated when kept an hour or two at a red heat, at the bottom of a crucible filled with *well-dried* charcoal powder and lime or sand, as tightly pressed down as possible, the following experiments were made.

*Experiment* A.—A crucible was inverted full of sand (of course previously heated) on the one containing the iron filings, charcoal powder, (previously

* Dr. Henry (Elements of Chemistry, article Light,) has broached the idea founded on Sir H. Davy's experiments, that the red end of the spectrum, which is the calorific end, tends to oxygenize matter. But the only examples he has adduced of such effects, are phosphorus and the black oxide of mercury. On other substances, as the pure coloured oxide of lead, it seemed to have the contrary tendency. But that heat tends to oxygenize matter, if oxygen be present, is well known: and this seems all that Dr. Henry meant in the passage alluded to, except indeed that some peculiarity in the red rays, *besides their heat*, might likewise assist. I know of no author who has broached the opinion that a red heat partially oxygenizes in the sense used in this essay.

* Berzelius, Traité, tom. ii. p. 238. Although there is no reason to doubt this assertion, still those who have a powerful battery in their possession would do well to repeat the experiment, previously ascertaining that the hydrogen gas is quite pure; and afterwards being equally certain that the gold is really oxidized.

† Of course, as regards light, the reader will see that my opinions are directly opposed to Scheele's. If light contain ponderable matter at all, it is probable that it contains hydrogen, in union with the luminous ether, so to call it. As Berzelius informs us that Scheele did not weigh the products in his enquiries on air and fire (Traité, tom. ii. p. 251,) of course Lavoisier had an infinite advantage over the Swedish chemist.

slightly heated) and lime, and the crucibles were bound together by a luting of clay and silex. These crucibles were kept at a full red heat about two hours. On being taken out of the fire, the luting was found without cracks, and the iron filings firmly agglutinated and quite black. The crucible was Hessian, but of unusual thickness, having been purchased at Genoa; and I suppose the layer of charcoal powder immediately above the iron filings was a quarter of an inch in thickness.

*Exp.* B.—A copper tube, about four inches long, was now filled for about a quarter of an inch with iron filings, then with heated lime powder about two inches, then heated charcoal powder half an inch, the rest with heated sand, over which was a round piece of thick copper exactly fitting the tube, and then was a luting as above. Exposed to a *dull* red heat for about two and a half hours, and then left at a still lower heat an hour, the filings on being taken out were found *not to be agglutinated*, but to have lost their metallic lustre and become blackish.* The heat in this case (as there was no agglutination of particles) was not so great as the preceding, but was longer continued: I was fearful the solder would not bear a higher heat.

*Exp.* C.—Copper filings were put in a small *covered* platinum crucible, over which was a luting of clay and sand; above the filings were heated lime and carbon powder, sufficient to fill the crucible completely, which was exposed to a bright red heat only about half an hour. On being taken out the filings were found to have lost little or nothing of their lustre.

*Exp.* D.—A quantity of bright iron filings, weighing 60 grains, were put in a small iron crucible, over which was inverted another, the two crucibles being well luted together by a mixture of clay and sand as usual. The first crucible was now nearly filled with lime, well dried as usual, and about a quarter of an inch of well-dried charcoal was put at the point of juncture of the crucibles, the remainder of the inverted crucible being filled with lime, all the powders being well pressed down. The whole was now exposed to a full red heat, at times nearly white, for about two hours. On being taken out the luting was found to have remained perfect, the filings were converted into a conglobated greyish mass, and had lost all their metallic lustre; a piece of bright iron wire placed upon them was also found to be tarnished throughout.

*Exp.* E.—Sixty grains of the same iron filings were again taken and put in a similar crucible, covered with a piece of sheet copper to fit exactly. The crucible was luted like the last. Instead of lime, charcoal was put immediately upon the iron filings and the lime at the top. Exposed an hour to a bright red heat, and on being taken out the filings were found to retain their lustre; but on being exposed three hours longer to a similar heat they lost all lustre entirely, notwithstanding that well-dried charcoal, half an inch thick, was in this case placed immediately upon them. The above experiments, with all the like precautions to exclude air, had been previously made in a platinum covered crucible; the iron filings were found to have suffered a like change.

*Exp.* F.—A similar weight of copper filings heated in the above way in a tightly covered fluted platinum crucible, with an inch of well-dried charcoal *immediately* upon them, after nearly five hours, were found to remain unchanged in weight, and to retain their metallic lustre, which, however, was changed in appearance to a colour like brass filings; yet the copper from which they were taken appeared to be pure.

*Exp.* G.—These same filings were again exposed for three hours in a small iron crucible to a full red heat, half an inch of lime being immediately upon them, and upon this about a similar thickness of powdered charcoal. On being taken out they were found to have regained the usual colour of copper, and to have neither gained nor lost in weight. There could be no doubt this time that they had been exposed to a full red heat, as on taking the crucible out it was found red hot at the bottom; the part in juxtaposition with the filings. I purposely was particular on this point, because I thought it possible that the bottom of the

* A piece of plumbago put in this tube at the same time as the iron filings was found not to have lost in weight. It was placed immediately upon them. I found that some of the same plumbago, heated in a deep crucible full of sand, at a red heat two or three hours, lost 3 parts in 58, without being rendered perceptibly harder.

platinum crucible, in which they were first heated, was not kept so hot as the centre, or surface.

Seeing that in all the above experiments charcoal was present in the luted crucible, it is obvious, under such circumstances, that copper cannot be oxidated, (since carbonic oxide, or carbonic acid is formed,) as experiments at the end of this essay, subsequently made, will still further convince the reader. However, as I found copper wire to lose some of its lustre, and copper foil to be completely oxidated in luted crucibles where no charcoal was used, I am inclined to believe, that by long-continued slight heat, copper may be tarnished without access of air.

Silver too appears, to a slight extent, oxidable under like circumstances. In two different experiments a half franc piece was found completely tarnished by remaining three hours at a red heat in a luted crucible. In the one case it was placed below a thick mass of iron filings, which was likewise blackened. No change of weight was perceptible in the half-franc piece.

*Exp.* H. — Experiment A was repeated, (with the same crucibles luted,) save that lime was placed immediately above the iron filings, (charcoal being placed above,) and as well as some fine iron wire placed with their wire weighed. The former weighed, before exposure to four hours' red heat, 240 grains; after, 254, and were quite grey throughout. The latter, before, 180 grains; after, 133 grains, being tarnished throughout. In both these results, but particularly the former, the increase of weight is a little over-rated in consequence of the difficulty of freeing the metal from chalk, or other powders in which it is immersed.

*Exp.* I.—Ninety grains of iron filings were put in a well-covered and luted platinum crucible, and exposed to a red heat for three hours. They were covered with well-dried charcoal powder; and a mass of charcoal weighing 8 grains, was also put in. The luting showed no cracks, and no increase of weight was perceptible in the filings, which had lost all metallic lustre. The mass of charcoal had lost three-fourths of a grain.

In two other similar experiments in iron crucibles, where 60 grains of filings were used, no increase of weight was found. However, in the former case there might possibly have been an increase in weight of three-fourths of a grain, and in the two latter, of half a grain, owing to want of delicacy in the scales; and in addition, it may be stated that the very nice determination of weight is almost impossible where filings are used. That the oxidation was very slight in all these cases was shown by exposing similar portions of them to red heat in an open crucible, and comparing the gain of weight with bright iron filings similarly circumstanced: it was nearly the same in both cases.

The following experiments show what a very slight extent of oxidation will completely change the appearance of iron and copper.

*Exp.* K.—119 grains of sheet-iron gained 1¼ grains in two minutes, (just time to make red-hot,) and the polish was taken off, the surface being only blued.

A bright piece of copper (weighing 152 grains) kept red-hot two minutes, gained a quarter of a grain, continued a quarter of an hour red-hot, no increase of weight, yet surface blackened, and all metallic lustre destroyed. Might, however have gained half a grain, as scales so loaded would not turn under.

An iron rod lost some metallic lustre —in two minutes and a half red hot.

*Exp.* L.—Four drams bright iron-wire kept red hot a minute, and then put under sand, was found of a greyish colour all through, yet no observable change of weight. It might, however, have gained 1 grain, for the scales so loaded would not turn under.* Three drams of iron filings put in a red hot crucible, and made red hot, and then left to cool, (about ten minutes altogether,) gained 3 grains, and were quite without metallic lustre. Heated an hour or so longer gained 16 grains more, with little change in appearance.

*Exp.* M.—Sixty grains of iron filings were put into a small iron crucible well luted, and kept at a red heat about half an hour. The filings on being taken out, were found tarnished, not altogether having lost their metallic lustre. Iron filings in a red hot open crucible only three minutes had more completely lost their metallic lustre.

*Exp.* N.—Sixty grains of iron filings

* Put again for an hour or so at a red heat, gained three grains; yet little difference to account for it in appearance.

kept eight minutes in an open crucible at a heat below redness, gained half a grain, and were rendered very slightly blackish. In about half an hour (the crucible scarcely having been red hot a minute) the iron gained two grains, being apparently thoroughly oxidized.

*Exp.* O.—Sixty grains of iron filings three minutes only in a red hot open crucible, well stirred with red-hot wire, gained 1¼ grain, and lost all metallic lustre; put in again for twenty-five minutes at a red heat gained 1 grain more; but with little change of appearance.—Again, two hours at a red heat—no further gain.

*Exp.* P.—Fifty-four grains of fine iron wire and 9 grains of well-dried charcoal (in one piece) were put in a small platinum crucible. Well-dried charcoal powder was now added, so as to completely cover the iron wire, and above the charcoal was well-dried chalk in powder. This being tightly pressed down, a platinum cover and good luting were now applied. On being kept only about three-quarters of an hour at a red heat, the iron wire was not oxidated or tarnished, but the charcoal had lost 1¼ grain. Put in again with iron wire (luting, &c., being made equally secure) for three hours at a red heat, no change of weight was found either in the iron or charcoal, but the wire was thoroughly tarnished (oxidated) though completely immersed in charcoal powder. There might, however, have been half a grain of increase of weight, as I found this was necessary to turn the scale used, when loaded with 60 grains; there might, for the same reason, have been a loss of nearly one-quarter in the charcoal.

In another similar experiment in the same crucible, 42 grains of fine iron wire, put under well-dried chalk powder only, gained 1½ grain in three hours, and was tarnished grey throughout. But the luting did not stand *so well in this case* as the former.

*Exp.* Q.—Copper filings weighing 42 grains were left eight minutes in the fire (crucible not being made red hot,) they were weighed before cold, and changed from bright to black *all through as seen on white paper*, yet had not gained more than one quarter of a grain—barely that. Left in again about an hour at a dull red heat, gained one grain. Another hour scarcely gained a quarter of a grain more.

Some copper filings were put in a tube, and mercury two inches deep poured upon them. On boiling the mercury the surface of the copper became coated with mercury, and no way oxidated. Iron filings under the same circumstances did not, in the first experiment, appear tarnished, though they seemed very slightly so in the second. But in the views taken regarding the oxygen of heat, viz., that it appears to exist chiefly in a red heat and above this, we could scarcely expect a change. Besides the heat was only just continued to the boiling about ten minutes.

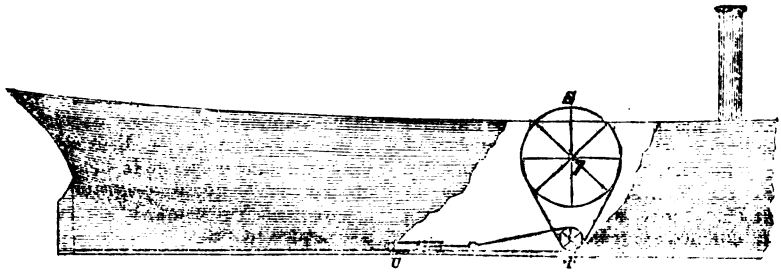
The following experiments were made to see if metals are oxidized in the interior of flame. A lamina of silver or copper was not blackened till brought to the point of the flame.

Some fine iron wire was held *in* the flame, and some at its extremity. Both were oxidated, but the latter in a decidedly greater degree. The same was the case with fine steel wire. Kept in two minutes the surface was only tarnished—but very obviously tarnished. As the point of the flame is the hottest, and as we shall show by experiments, to be mentioned presently, that increase of heat increases oxidation in a very remarkable degree; the increased oxidation, when the wire was in contact with the air, may have depended in a great degree on the heat at such point being higher. This view of the subject was supported in some degree by the fact that whether the wire was held in the interior of the flame constantly, or taken out two or three times, the amount of oxidation seemed not greatly different.

These experiments do not support the opinion of some chemists that the *interior* of flame is a disoxygenating agent. But even granting that in some cases it exercises such power, this will be no objection to the view that heat is, *per se*, an oxygenating power; for as the *interior* of the flame contains strongly heated carbon (perhaps as carbonic oxide) this effect of carbon would be to disoxygenate, supposing the heat itself to have a contrary tendency. So that even admitting such disoxygenating power in some cases, still iron is certainly oxidated in it though copper and silver are not; only proving that iron can take oxygen in circumstances that copper and silver cannot, as was to be expected from its greater affinity for oxygen.

(*To be continued.*)

NEW PLAN OF PROPELLING—PROPOSED AS A SUBSTITUTE FOR THE SCREW IN THE "GREAT BRITAIN."




The above figure is drawn according to the dimensions of the *Great Britain* steam ship, as described by Mr. Hill, (vol. xxxvii. p. 242.) The whole power of the engines, 1000 horses, being applied to the crank axle of the large driving-wheel, S, is communicated by a strap [chain] to the pulley T. The cranks on the main shaft of the driving wheel being 3ft. long, and making 18 revolutions per minute, and the diameter of the driving wheel being 26 feet, they would give about 230 horses power at the circumference of the driving-wheel. This force being transferred to the pulley, the diameter of which is 5 feet, making 80 revolutions per minute, is communicated by a long shaft to the screw at the stern of the vessel, and the screw being 15 feet in diameter, the diameter of the circle of effect would be about 12ft. 6in., or 92 horses power. I will, however, consider the diameter of effect to be 10ft. only; this would give 115 effective horses power. Now if for the screw we substitute two pistons and cylinders, U, (one only is shown in the figure,) open to the water at the back, and connected by a crank shaft to the pulley, T, making 80 revolutions per minute, each piston making 80 forward strokes, 10ft. long, they would give 18 miles an hour as the rate of propulsion. Supposing the effective power exerted on the piston to be the same as that on the screw, viz, 115 horses power, the diameter of cylinder required would be about 24 inches, reckoning the pressure of the water at the depth which the cylinder would be immersed (14ft. to 15ft.) to be 5lbs. per square inch.

The cylinders are proposed to be placed on either side of the top face of the keel, the vessel being gradually curved from thence to the stern.

In the foregoing calculations I have not considered the additional power that would result from the pressure of the water on the piston at each back stroke, as it is obvious this would be nearly in proportion to that required to displace the water at each forward stroke, I may fairly conclude that a saving of nearly one half of the power would be effected.

W. K. T.

Petworth, May 2, 1846.

CAMBRIDGE "GRACES" AND ACADEMIC REVOLUTIONS.

The world is a phantasm, and all things about us are in a state of change. The conservative principle of party is apparently annihilated, and new combinations of men, things, and ideas are become matters of daily occurrence. We have actually ceased to wonder at events such that only a few years ago we should have deemed the prophet who could foretel them, as a fitting occupant of the mansions at Hanwell or St. George's Fields. Still some events do startle us, not so much by their ultimately occurring, as by their occurrence at a time so much earlier than we could have anticipated.

A case in point is before us—two *graces* which passed the senate house of Cambridge on Wednesday, May 13, relative to the future conduct of the examinations for "honours." Every one must see that in a public educational institution the course of study is always governed by the nature and character

of the examinations; and we have only to note the senate-house papers to see that the system pursued in that University was only calculated to make dextrous analysts, whilst it was inevitably productive of the most lamentable effects upon the intellectual faculties of the "Questionists." A man who had never given a moment's thought to the real foundations of the several branches of mathematical science could "walk up into the highest honours," whilst in many cases men of the first powers, who had pursued a course of systematic and judicious study, either fell into neighbourly fraternity with "the wooden spoon," or else went out in the "gulph." In fact, men have not been in the habit of going to Cambridge for the sake of study, but for the sake of the worldly advantages which they supposed would accrue from spending their three years in the University. One man pursues a prescribed course for the sake of honours, another "crams" sufficient for taking a "common degree;" both fulfil the conditions, and both obtain their objects. The university chest, too, is filled, and the university functionaries become wealthy; and thus the specific objects of all parties interested are attained. All are satisfied, and the "thing works well."

How, then, comes it to pass, we ask, that a system which has so well answered every body's purpose has been suddenly reversed? We confess for our own parts that it takes us by surprise; and we shall much wonder if the authors of this reform have not been more successful than they anticipated. That there were, indeed, *principles* at work which must have led to such a result was evident to every one acquainted with the University; and even Universities, "laggard" as they proverbially are, could not for ever resist the influences that modify the general tone and tastes of society. A glance at its recent history will throw some light upon this subject.

An "Anti-Gallican" and conservative feeling had so intensely infused itself into the mathematics of Cambridge, that the efforts made by Woodhouse, in the beginning of the present century, to introduce a small portion of the continental discoveries into the University, met with the most violent and disingenuous party opposition. He was, therefore, personally successful to only a very limited degree. Yet his ardour never cooled, and his *ésprit* was at last infused into other bosoms. The same university year (1815) produced a Herschel, a Babbage, and a Peacock—men, whose writings, personal intercourse, and corporate influence established the "new analysis" on a secure footing in the University. A very remarkable change in the character of the senate-house questions became apparent—a new course of reading must be adopted to prepare for that ordeal—new text-books were produced in abundance—and the entire machinery of mathematics was metamorphosed into clumps of complicated symbols—whilst a geometrical figure was as much proscribed as an old surtout at a royal levee, or a round hat upon military parade. Other great names and gifted men have subsequently appeared upon the University boards, and many deserving of all the honours still grace that position. Able discussions of intricate topics have proceeded from university pens, and difficulties of considerable magnitude have been removed by men trained at Cambridge.

Yet look at the other side of the picture. It is not to the influence of a system upon the minds of a few of the more gifted of our race, but to its influence upon the great mass of students who repair to Cambridge, that we must look, to ascertain the real effects of the system of which we are speaking. The English mind has less of the *ideal tendency* than perhaps the mind of any other people. The abstract conceptions involved in the more refined analytical theories may perhaps be *understood* by us when propounded: but it is not the region of thought in which we are *naturally* constituted to exert our faculties. Dexterity, in the combination of symbols, we may, and do acquire, as we acquire facility in any other kind of *manipulation*—for it is, in essence, not materially different from mere manipulation; but those almost evanescent shades which constitute the foundation of analytical theories, are of a kind which we, as a people, have no real capacity for discerning and seizing. In fact, as a general (though not quite universal) statement, we may affirm that our English analysts have at best only worked out the little details

of the particular problems and methods that had been, on the large scale, already discussed by the continental ones: in short, that they have played the part of *manœuvriers* to their Gallic masters in the science.

This opinion is verified, too, by the fact that whatever be the "honours" taken by the ablest men, and whatever be the reputation which their few first years may gain them, eventually they have *invariably* deserted pure analytical research for some pursuit more congenial to their powers, and more closely allied to their native tastes. Herschel turns to physics, Babbage to machinery, Peacock to the metaphysics and history of mathematics, Airy to practical astronomy, optics, and the tides; whilst Whewell labours to rival Paley in moral disquisitions, and to restore Newton and Euclid to the university. Of the great mass of men who go out in honours, however, we never hear again in any capacity beyond that of some snug and comfortable local appointment. They went into the senate-house like expanded sponges, dripping with science; they left it like sponges squeezed dry and shrivelled up to less than their natural dimensions! Their science will have answered *their* purpose if it procure them a "comfortable berth,"—and this it seldom, we believe, fails to do. Having no other idea of science than as analysis, and little skill even in this beyond that of legerdemain,—they have little affection for the subject itself, and have acquired no powers of independent research. We cannot, therefore, feel surprised at their disappearance from the stage, the instant their parts are acted out.

If we look at the analytical compositions that have proceeded from Cambridge men, we must be struck at once with the fact that scarcely an *original idea* upon any analytical subject has emanated from that source,—we mean, of course, any broad fundamental conception, calculated to alter the face of the science, and effectually improve its processes. Cambridge men have read the French and German analyses,—have adopted, modified, and frequently improved isolated parts of them,—have been most assiduous in making converts to the analyticals ystem,—have followed in the wake of our French neighbours like a fleet of small boats tied to the stern of an Indiaman, sailing up the Thames. Their *real originality in analysis*—where is it?

Again, look at the great mass of Cambridge class-books. Take away some conundrum respecting differential and integral notation, or some "short proof" of a fundamental principle, (often as fallacious as it is brief,) and it would be easy, in a moderately good library of French mathematics, to take down one book after another, and point out the places from which the very best of our Cambridge books are manufactured. We not only import the raw material; we import the "stuffs" ready made. We feel it due, however, to Mr. Hind, to except several of his works from this category; for, though the materials are not of English growth, the work is English,—sensible, judicious, free from absurd affectation, and totally divested of that nauseating quackery which disgusts us in so many other elementary works that are issued from the "Pitt-Press." Most, indeed, of the works to which we have referred have had but an ephemeral existence; and were only written by men who possessed an ephemeral reputation and influence. Their value passed away with the college-fellowships and tutorships of their authors; and many of them did not live out half that brief period. The chance of making a little money by their sale, or by the "grist" they would bring to the author's mill, was in fact the sole motive that called them into existence. They have done their business in the University, and are either consigned to the trunk-maker and butter-chandler, or grace the stalls of the secondhand bookseller; tempting the unwary but solitary and unguided student to purchase a work, which, bearing "Cambridge" on its title-page, must be presumed to be a safe guide to him in acquiring a knowledge of *modern* mathematical science! Is there nothing in a name? Alas! much, much, either of good or evil,—though most often of the latter.

Of course, a constant staff of official persons must be kept up in the University itself; and though the duties of fellows in *some* of the colleges are far from agreeable, yet they furnish a handsome provision during celibacy, and generally some solid and permanent rewards in after-life. This will always secure to the University a certain num-

ber of able and intelligent men—alive to its best interests, and desirous of introducing every possible improvement into its system. Such as these, however, after all, are most likely to form a small minority of the college-fellows and actual governors of the corporation. The far greater number are men of comparatively little physical, intellectual, or moral energy: men who are satisfied with the system they found there, because too indolent either to think out the results, or to trouble themselves about "theoretical changes." Satisfied with their posts and prospects, they dream away their days in a state of quiet enjoyment, such as the University table furnishes to profusion; and as to science itself, beyond that elementary and routine portion which constitutes their occasional subject of college lecture, it may verily be said of them,

"The full-grown baby still his coral keeps,
And sucks the thumb of science till he sleeps."

But what is the influence of this system upon the *polloi* of Cambridge? Men with moderate intellectual powers at the best, and occasionally below the medium standard, with little inclination to study, and that little inclination overcome by the seductions of boating, racing, wine-parties, and town-and-gown rows:—how should these men be expected to shine in the *gymnasium* of analysis, or devote their precious time to such a "confounded bore"? Oh dear no—the "fast man" never studies:—at least till he enters upon his last term, in which he crams up under a private tutor, a few answers to such questions as it is pretty well foreknown will be made the qualification for an "ordinary degree." This he calls *study*, and hard work enough it is to him, poor soul! Yet is this *education*? We believe we are not far wrong when we say it is the amount of mathematical education, attained at this far-famed University, by more than a moiety of the men who go up for a degree. To the capacities of the great majority analytical studies are unsuited, and so long as none others, better adapted to their powers, are prescribed, it will be useless to expect the University system to become an efficient means of education.

These men go forth into the world with the appendage "B. A." to their names, which by a simple and undiscerning public is taken in as an irrefragable proof of their superior learning and superior talents. Their university rank in civil life has the same mark as if they had taken the first honours of their year; and it is obtruded upon public notice much more officiously than the same addenda are by men of the highest mark. Their habits having been formed in sheer idleness, with a fair sprinkling of those particular propensities which idleness is sure to generate, they are rendered incapable of any industrial occupation,—and have learned, indeed, to look upon all but a very limited class of pursuits as "below their station, and unfitted for their education!" However, something must be done; for though the University has "chested" their fees, it cannot afford them the "gentlemanlike employment" to which they aspire, nor still less refund them their little contributions to the "chest" with the ample interest required to enable them to live a do-nothing life. They have been in very many cases supported, during their "terms," from the limited means of parents and friends; and their remaining patrimony consists almost entirely in the magical talisman of the *degree*. What is the commercial worth of this, and how can it be turned to account?

So long as there are penurious rectors and vicars, either pluralists, or lazy men, there is always an opening for him who can drag through another year upon his own resources: he may obtain "a title to orders" upon the condition (under *bond*) of not "taking their deacon's stipend" from his beneficed employers. He furbishes up a little of his Latin, the New Testament, and *Paley's Evidences* to a degree of lustre almost equal to its condition before he left school; the bishop's chaplain goes through the farce of an examination, and the Right Reverend Father of some diocese or other, anoints him to the sacred function of a Christian teacher. The year rolls on, and he is ordained, as a matter of course, a priest; two years more, and some ten pounds or so, also creates him a master of arts. He marries, perhaps, to a few hundred pounds, and either purchases a small advowson or opens a school, upon the duties of which he spends the remaining labours of his life.

Others, who cannot even get over the deacon's stipendless year, supply our

proprietary schools with *mathematical* masters, and frequently our private schools too; or they get some humble appointment in the public service, which is supposed to require a vast amount of such science as the public is pleased to call "mathematical," though the stipend offered is less than that of a clerk in a merchant's office, or even than the "salary" of a parvenu's butler. If, however, adverse events shall have rendered it necessary for the ablest man in England, who is not invested with a University degree, to seek the same employment, the raw, inexperienced, and ignorant "B.A." is preferred before him! Nor is this confined to the public service. If a little corporation endowment, or a joint-stock speculation in the educational way, have to seek a master (especially for mathematics) it is useless for any one to offer himself, however high his credentials, if he be not able to display these literal elements of a future tail to his name! We have witnessed instances which make us blush for official and public credulity—ay, even in *important* branches of the public service. Talent, learning, science, experience, judgment, all retired abashed from the unequal contest with pretension, ignorance, and charlatanism, for bread and existence.

The University system is not to be wholly blamed for these things; but it is not altogether free from blame. Of course the University receives as many *alumni* as she can manage to lodge in college, hall, or supervised private houses. It is the pecuniary interest of the University to do so; and still more, it has been till lately considered a proof of the celebrity and of the excellence of the system, to attract so many students. Interest and a love of fame combined to spur the "Heads" to greater exertions to maintain their position in the world of letters and of science. The reputation of the University for its mathematics at least must be upheld; and this could be no otherwise done than by supporting the pretensions of their own pupils amongst the great public. There has thus been lent a kind of practical sanction to the pretences of these mere drivelling empirics. For these to lose caste in public estimation would be for the University itself to lose caste in the collegiate world:—for these practices to lose their effect would tend to diminish the "numbers on the boards" and contract the flow of cash into the University—exchequer.

Looking at Cambridge in the light of a corporate commercial body, all this can be easily understood; but looking at it as the fountain of a "liberal education," and conducted by men of enlarged, liberal, philanthropic, and Christian principles, such conduct is truly anomalous. In a railway speculation or a colonial enterprise, such a system is expected, and is not, perhaps, unbecoming or blameable; but to see pure science adopting the coarser maxims of mere trade, does indeed shock our sense of propriety and consistency.

We have spoken freely, but in no angry or unkind mood. We feel the more at liberty to so speak, from our personal knowledge that our own views coincide with those of several of the most learned and high-minded resident members of the University. We know that they lament this state of things, and are exercising their best energies and great influence to abate this crying nuisance—this scandal of their system. They are succeeding beyond expectation; and this success amongst a constituent body proves that our views are entertained by the *majority of the active constituents*.

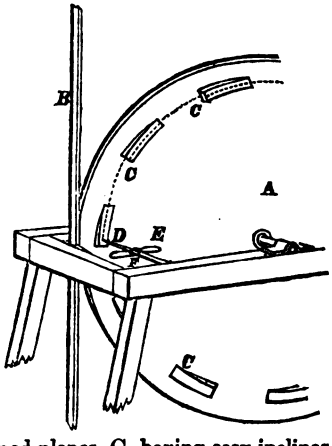
The "two graces" to which we have referred, imply much more than would appear upon the face of them, to any one not acquainted in some degree with the details of the Cambridge system. In a future article, we shall attempt not only to explain these two "acts" of the "academic parliament," but to trace their inevitable consequences. It will then be seen that a veritable *academic revolution* has much more than commenced. May interested and party—disingenuousness not succeed in overthrowing by oblique means a movement which it dared not openly resist!

(*To be continued.*)

## BACHE'S MACHINE FOR MEASURING THE VELOCITY OF THE PISTON AT DIFFERENT PARTS OF ITS STROKE.

This machine, invented by J. Bache, of Perran, consists of a circular disc, A, free to move on its axis, by the friction of a rod, B, against its edge, the rod receiving motion from the beam, or parallel

motion of the engine. On the face of the disc, near its edge, at similar distances from the centre, and equal distances from each other, are placed a number of in-

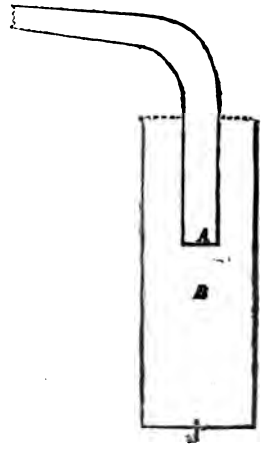



clined planes, C, having easy inclines on one side, and perpendicular faces on the other,—the face of each being opposite to, and at some distance from, the incline of the next. Perpendicular to the disc, and so placed that the inclines shall pass in succession before it, is a pencil or marker, D, constantly pressed forward by a spring, E, and kept in its place by being make to work in a tube, F. As the disc turns, the pencil rises over the inclines, and falls over the perpendicular faces, each time at a distance proportionate to the velocity of the disc, and the rod moving it, which may be supposed to have the same motion as the piston.

The time the pencil takes in falling,—which is always the same, and is that in which each of the measured parts is done, may be obtained by making the disc revolve once at a known rate, finding what part of the circle described is passed or jumped over by the pencil, and dividing a similar portion of the time in which the revolution was made, by the number of inclined planes. From this, the actual velocities may easily be found.—*Trans. Royal Polytechnic Soc. of Cornwall.*

### CONDENSING RECEIVER FOR THE ESCAPE STEAM OF HIGH-PRESSURE ENGINES.

Sir,—The following statement may interest some of your readers. I had carried a branch pipe from the exhausting pipe of a high-pressure engine around a room for the purpose of warming it. The end of the pipe was against an outer wall, and I found some inconvenience from the discharge of steam from it. This I remedied in the following manner:—




A, in the above figure, represents the extremity of the steam-pipe; B is a cylindrical vessel of a diameter somewhat exceeding that of A, and having a bottom with a very small hole in it—a hole of such a size as to discharge water at a somewhat slower rate than the condensed steam flows from the extremity of the steam-pipe when warm. When the steam is turned on, B, being empty, allows a free passage for the air from the steam-pipe, A. After a time, the water accumulates in the vessel B, covering the extremity of the pipe, A, thereby preventing the egress of the steam. When B becomes full, the condensed steam flows over its edges and down its sides. By these means I prevented the escape of steam, and was able to dispense with a blowing cock. The depth of B below A must be such as may be found requisite to allow all the air to be blown out of the steam-pipe prior to the condensed steam rising to A.

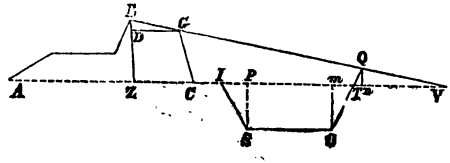
The height of the vessel B above A, must be such as will give the column of water requisite to resist the pressure of the steam. L. L.

May 15, 1846.

SOLUTIONS OF THE PROBLEM IN "MENSURATION." (NO. 1186, PAGE 327.)

*First Solution.* By Mr. ALEXANDER COLVIN.

ABGC = 100 feet
BD = 1
DG = 6
BZ = 10
ZP = 13
PS = 6 (depth of ditch.)
IP = 3




Draw the perpendiculars O$m$, and Q$n$

Now BZ : ZV : : BD : DG

$\therefore$ ZV = 60

Again, the perpendicular Q$n$ divides the triangle QTV into two triangles QT$n$ and Q$n$V respectively similar to O$m$T (or IPS) and BZV (or BDG.) Hence

Q$n$ : $n$T : : O$m$ : $m$T : : 6 : 3 : : 2 : 1
and Q$n$ : $n$V : : BD : DG : : 1 : 6 : : 2 : 12.
$\therefore$ Q$n$ : $n$T + $n$V (=TV) : : 2 : 13

Consequently, $Qn = \frac{2}{15}$ TV, and area of triangle QTV $= \frac{Qn \times TV}{2} = \frac{1}{15}(TV)^2$

Now let $x$ = P$m$, then IT (width of ditch) $= x + 6$, and TV $= 60 - (x + 16) = 44 - x$; also, area of triangle QTV $= \frac{1}{15}(44 - x)^2$ and area of ditch $= 6x - 18$.

Hence by the question, $6x - 18 = 100 + \frac{1}{15}(44 - x)^2$.

This equation solved, gives $x = 20{\cdot}654$;

$\therefore$ IT, the width of the ditch $(= x + 6) = 26{\cdot}654$.

Southwark, May 11, 1846.

*Second solution.* By CENTURION.

Since tan V = tan BGD = $\frac{1}{6}$,
and tan T = $\frac{6}{3}$ = 2, we have

$\sin V = \frac{1}{\sqrt{37}}$, $\cos V = \frac{6}{\sqrt{37}}$,

$\sin T = \frac{2}{\sqrt{5}}$, $\cos T = \frac{1}{\sqrt{5}}$. Also,

$\sin Q = \sin (T + V)$
$= \sin T \cos V + \cos T \sin V$
$= \frac{13}{\sqrt{5.37}}$.

Now put IT = $x$, and TV = Y; then

area TQV $= \frac{1}{2}$ TV$^2$ sin T, sin V cosec Q
$= \frac{y^2}{13}$ ..... (1)

area ISOT $= \frac{1}{2}$ SP (SO + IT)
$= 6x - 18$ ..... (2)

And by the question, we have

$100 + \frac{y^2}{13} = 6x - 18$ ..... (3)

But ZV = BZ cot V = 60 ..... (4)
and ZV = (ZP − PI) + IT + TV
$= 10 + x + y$ ..... (5)

And equating (4, 5) we get $x + y = 50$ (6)

From (3, 6) we find

$100 + \frac{(50 - x)^2}{13} = 6x - 18$,

which resolved, gives

$x = 89 \pm 62{\cdot}34582$.

The only solution of this applicable to the question is when − is taken, and we thus have

$x = 26{\cdot}65418$ nearly.

*Schol.* Dalby's answer is 26·67; but it was, probably, obtained by making the extractions in the course of the work, instead of deferring them till the close.

THE "NEW THEORY OF THE PRISMATIC COLOURS."

Sir, — In page 366 of the current volume are some observations on prismatic colours, in which it is endeavoured to prove that light of different colours has different velocities. The following considerations will show that there are strong *à priori* reasons against many of the propositions adduced:—

1st, The experiment there alluded to upon radiation, proves not that the caloric rays proceed with less velocity from one surface than another, but that there are fewer of them.

2nd, It is a known fact that in a plane perpendicular to the axis of different coloured lights, the velocities of the vi-

brations are different, while the velocity of propagation of the motion among the particles of ether is the same.

Now this difference in the velocities of transverse vibrations is surely sufficient to cause the various sensations of colours in the eye.

3rd, The velocity of light, whether it be the same for all colours or not, is known to be uniform for each. Your correspondent compares the velocity of a ray of light with that of a projectile, at the same time forgetting that if no force acted on the arrow, for example, the velocity with which it was projected would not be changed during its flight. Now, light in free space moves in a medium offering no resistance, and we have no reason to conclude that the attraction of gravitation alters the elasticity of the ether, which is put in motion by the action of light.

4th, Supposing one kind of light to have a velocity $\frac{1}{1000}$ less than that of its complementary colour, by an easy calculation your correspondent will find that in an eclipse of one of Jupiter's satellites, the appearance on emergence would be that of a satellite of just one colour; and then when the other colour had arrived at this earth, after a time quite appreciable, the satellite would be of the combined colour.

5th, Since the aberration of a star depends on the ratio of the velocity of light to that of the earth, if various coloured lights had different velocities, the star would appear a complete spectrum.

I shall just add in conclusion, that if this property of light were to be proved true—there would be no greater simplicity in supposing different colours to have different velocities, than to suppose *different kinds* of light. I remain, &c.,

J. M.

Trinity College, Cambridge, May 20, 1846.

## THE "GREAT BRITAIN" STEAMER AS SHE WAS AND IS.

We mentioned some time ago that the machinery of this vessel was undergoing very extensive repairs under the direction of Messrs. Maudslay, Field, and Co., and hinted, in terms which have been deemed harsh, that she had been found defective to a degree which would cause some surprise in the engineering world. The repairs having been completed and the vessel being once more on her way across the Atlantic, we now propose to show by a general comparison of her capabilities before and after the changes which have been made in her engines, that we had good reason for all we said on the subject.

On the opposite page are two indicator diagrams; one (No. 1) showing the utmost mean pressure at which the engines of the *Great Britain* could be worked with her machinery as originally constructed; and the other (No. 2) showing the mean pressure attained after that machinery was altered. The correctness of these diagrams will not, we believe, be disputed. From these it will be seen that the attainable mean pressure has been increased from 5¾lbs. per square inch of piston to 11¾lbs. The consequent increase in the number of strokes per minute has been from 13½ to 16.

Now, with the help of these data, and keeping in mind that the cylinders are 88 inches in diameter, and the length of stroke 6 feet, we arrive at the following calculations.

H. P. *before the change.*

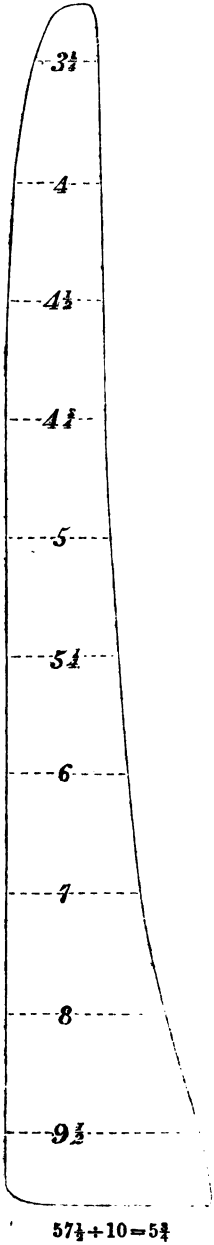
6082 area of cylinder × 12 twice the length of stroke × 13½ number of strokes × 5¾lbs. pressure per square inch of piston ÷ 33,000, gives 171·6 as the H.P. of each cylinder, which, multiplied by 4, the number of cylinders, makes the total H.P. 686·4.

H. P. *after the change.*

6082 × 12 × 16 × 11¾ ÷ 33,000 = 415·8 × 4 = 1663·2 H.P. The real gain in H.P. has therefore been (1663·2 − 686·4) not less than *nine hundred and seventy-six horses power.*

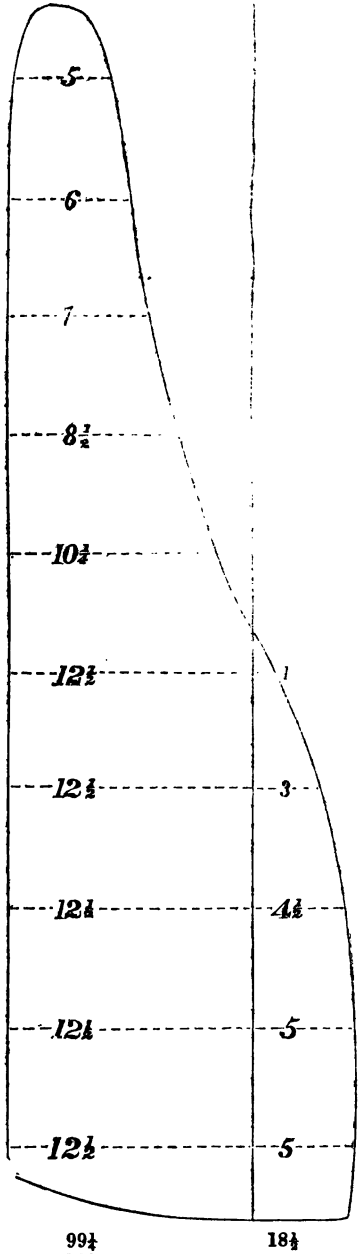
An enormous difference this; and the more remarkable that it has been achieved by no alteration in the dimensions of the boilers or cylinders, but simply by more skill and tact in developing their respective capabilities. Fire-flues and steam-ways have been enlarged which were before ridiculously narrow; air-pumps which bore previously no proportional relation to the steam cylinders to which they were applied, have been made equal to the duty required of them; and expansion-valves have been adjusted with a nicety (as the diagram No. 2 strikingly evinces) by which probably the utmost possible amount of work obtainable from each cylinder-full of steam is realized.

No. 1.




$57\frac{1}{2} \div 10 = 5\frac{3}{4}$

No. 2.




$99\frac{1}{2}$
$18\frac{1}{2}$

$117\frac{3}{4} \div 10 = 11\frac{3}{4}$

$18\frac{1}{2}$

## ON THE CENTRIFUGAL DRYING MACHINES ON SEYRIG'S PRINCIPLE.*

The separation of water from textile fabrics, or the operation of drying, must, from the earliest ages, have been a subject of considerable importance; and any improvement effected therein cannot fail to be generally interesting. The different methods now adopted in our manufactures are little more than the carrying out, on a larger scale, and with more scientific machinery, the ideas and practices of past times. These methods may be enumerated as follows:—*First*, The evaporation, dissolution, and carrying off the water by hot air, or drying by heat. *Secondly*, The forcing together of the fibres of the texture, so as to drive the water from between them,—this is performed by wringing, or pressing, or passing through rollers. And, *thirdly*, effecting the separation by means of the weight of the water; and for this purpose two modes are adopted,—one in which the water, by its gravitation merely, is made to separate itself from the fibres, which is by dripping, or draining; and the other in which rotary motion is employed, so as to give the effect of an immense artificial increase to the weight of the water to be separated, and thus quicken the operation of drying in proportion to the artificial increase of weight so given. The common domestic operation of trolling a mop is a familiar example of this last plan. The invention about to be described belongs to this last class, as it depends for its effect on rotary motion.

To see clearly its value, it is necessary first to examine the principles on which its operation depends, and thus to see why those principles have hitherto produced effects very limited in comparison with their power. Water retains its connection with fibrous substances with some degree of tenacity. This arises partly from the adhesion which takes place between the surface of the fibres and the water, and partly from the capillary action of the innumerable small interstices formed by contiguous fibres, and of the minute tubes of which fibrous materials are mostly composed. From these causes some degree of force is necessary to separate the water from the fibrous matter, and we know from experience, that although it is easy to get rid of part of the water, still the remainder requires great force, or peculiar contrivances for its expulsion. If a hank of cotton, or other fibrous material, filled with water, be hung up, a certain portion of water will drain off, that is, the weight of the water will be sufficient to tear much of it from its connection with the fibres; but the connecting force depends chiefly on the adhesion between the water and the fibres, and therefore, on the total area of the surface of the fibres which remains constant during the draining. But the draining away of part of the water will so reduce the weight of that which is left, as to render it incapable of drawing any more away, from its adhesive or capillary connection with the fibrous mass: when the operation has reached this point, the draining ceases, and, indeed, during the latter part of this operation, its progress becomes very slow, from the little preponderance the weight of the water has over the detaining force. If, at this stationary point of the process, we could increase the weight of the remaining water, without increasing its quantity, or decrease the force of the adhesive or capillary attraction by which it is retained amongst the fibres, it is clear that we should bring away an additional quantity of water; and when at length, the process was again brought to a pause, another similar addition to the weight of the water would still further drain the fibrous mass, and so on, as far as practicable or expedient.

Now, the effect of all contrivances for separating water from fibrous substances by rotary motion, depends on the fact, that they operate just as though they added greatly to the weight of the water; and it is obvious that the efficiency and value of each particular contrivance must chiefly depend on the degree in which it can be made to produce this *quasi* addition to that weight. The action of the machine throws the water off from the circle in which it was revolving, and the degree of force with which it is thrown off, and, therefore, separated from the fibrous matter, is correctly represented by this supposed addition to its weight. (The principles from which this effect may be deduced, are explained in Note A., including a table exhibiting the results in which the diameters are given in feet, and the number of revolutions are those performed in a minute; the results are stated in the number of times the weight may be said, for the purpose of this argument, to be increased.) Thus water, or any other substance, revolving a thousand times a minute in a circle of four feet in diameter, has a tendency to fly from the centre, round which it revolves, equal to 685 times its own weight,

* These machines have been already described in our pages, (see vol. xxxix., p. 257,) and form the subject of three several patents; two granted to Mr. Seyrig himself in 1838 and 1845, and one (a patent of improvement) granted in 1843 to Messrs. Keely and Alliott, of the firm of Messrs. Manlove, Alliott, and Co., of the Lenton Works, near Nottingham, by whom the machines are manufactured and sold.

and it would require a force of that amount to retain it in that circle, and prevent its flying off. If wet clothes are put into a suitable machine of four feet diameter, made to revolve 1000 times a minute, the water is thrown off with a force of 685 times its own weight, while the clothes are retained in the circle by the strength of the parts of the machine in which they are placed, with a force exceeding their weight in the same degree. It is important now to observe, that the last small quantities of water which remain in a fibrous mass, adhere to it with great force. To overcome that force, it is absolutely necessary to use great velocity of rotation, for lower velocities do not give to the water the requisite amount of tendency to fly off from the centre. A useful effect may be produced with a machine of three feet in diameter, making, say, 500 revolutions per minute, but after all it could possibly do, a large quantity of water would remain to be removed by the slower and more expensive process of drying by heat. But a machine of four feet in diameter, making 1500 revolutions per minute, would remove a considerable quantity of water which the other had left, for the centrifugal tendency imparted to the water would be but 128 times its weight in the first case, and 1542 times the same weight in the last. It will be observed that the effect increases both with the number of revolutions per minute, and the diameter of the machine, but much more rapidly with the former than with the latter. We are now in a condition to understand the value of high velocities of rotation in the process of drying by mechanical means, and at first sight, it seems that nothing prevents our obtaining as high a speed, and, therefore, as perfect an effect as we may please. But here some practical difficulties meet us, which must be explained, and which it is the object of this invention to remove. If a machine of this kind carried its load all on one side of its shaft, it is clear that the tendency of the revolving material to fly off would only be counteracted by the strength of the shaft. In the case we have supposed of a machine four feet in diameter making 1500 revolutions per minute, a load of only one pound so placed would require a shaft strong enough to support 1542 pounds of dead weight; and what is worse, that load of 1542 pounds would press on the journals of the shaft revolving at this high velocity, which must be made of considerable strength and diameter to hold it. An enormous friction and consequent waste of power would thus be occasioned. But a load of exactly equal weight on the opposite side of the shaft would at once remove this difficulty, for it would oppose an equal and opposite pressure to that which had produced the friction, and thus neutralize it. It is soon found in practice quite impossible always to load a machine, so that in each part the load is exactly equal, opposite, and at the same distance from the centre, and a failure in accuracy in any of these respects immediately reproduces proportionately the great pressure, friction, and waste of power, we have just described. If out of a dozen times of loading, any one load should be a pound heavier on one side than its opposite, the shaft and the journals would be exposed to just the strain already calculated as though the pound in excess were the only material in the machine. In some of the early machines of this kind, the parts appropriated to the load were divided into two or more boxes, into which the goods to be operated upon were placed, but in later plans this arrangement has been altered; the space allowed for the goods being continuous all round the circle, the body of the machine consisting of a hollow cylinder, with sufficient apertures in its periphery to permit the escape of the water. Now, the pressure on the journals we have described is brought on by the difficulty of loading equally either the boxes or circular machines just described: an operation of considerable delicacy if time and care could be bestowed upon it, but absolutely impracticable under ordinary circumstances. It is no unusual thing for such a machine to carry 2cwt. of fibrous goods at once; in the placing of which in the machine it is hardly possible to avoid an inequality in the loading amounting to a pound, and this trifling error in the case of the machine referred to of four feet in diameter, and making 1500 revolutions per minute, would produce pressure and friction enough to require five horses power more to work the machine than if it were equally loaded. The experiments from which this result is obtained, are referred to in Note B. The expense thus incurred would effectually prevent the use of these high velocities without further contrivances, and lower speeds must have continued, although the effect is so much less perfect. It became, therefore, an object of considerable importance, to devise a plan by which high speeds could be obtained without the enormous waste of power which had hitherto accompanied them. The Patent Drying Machine of Messrs. Keely and Alliott fully accomplishes this; the principles and general construction of which will now be explained.

If a solid body (no matter how irregular,)

unconnected with any fixed centre, be made to revolve (no matter how rapidly), its revolutions will take place round an imaginary axis, whose place is spontaneously ascertained by the mutual actions of the component parts of the body. It is an essential property of this spontaneous centre, that the outward pressure of the different component parts should be exactly equal on all opposite sides of it; from which it follows, that if there be any inequality of weight in different parts of the circumference, the spontaneous centre must be further from the lighter side than from the heavier, in order that the former may gain from velocity the amount of effect of which it is deficient from weight. But a pivot, or spindle, placed at the centre, so spontaneously found, and round which the forces were so balanced, would evidently exert no pressure in any direction on the bearings which might contain it. This end is obtained in the Improved Machine (an engraving of which was given in the *Mech. Mag.* vol. xxxix, p. 257.) The operation and effect of the contrivances there represented are as follows: On the cylinder being made to revolve, that side which is most lightly loaded will describe the largest circle, according to the foregoing principles, and to do so must draw the shaft out of the centre of rotation. The weights now obtain rotative, and consequently centrifugal, or outward force, and this force carries the weights to the lightest side, (because, as before explained, the lightest side is furthest from the spontaneous centre of rotation,) and thus, at the same time, restores the equilibrium of the cylinder and the revolving point to the centre of diameter. When the operation reaches this point, which it does in a few seconds, the cylinder revolves as it would do if it were free in space, and thus, though unequally loaded with goods, it rotates without lateral pressure on its bearings.

By this very simple contrivance, beautifully exemplifying one of nature's laws, and therefore, unerring in practice, the loss of power arising from unequal placing of the goods is prevented. Nothing now prevents the use of the higher velocities necessary for the extraction of the water, since the cause of the loss of power, and other difficulties heretofore attending the use of those high velocities, are altogether avoided. The other parts of the machine are constructed with a view to these same high velocities. It is obviously important that the cylinder containing the goods to be dried, should be composed of parts capable of withstanding the enormous outward pressure of the goods, occasioned by these high velocities, and at the same time be composed of light material, that it might not, by its own weight, tend to tear itself to pieces; accordingly, its cylindrical surfaces are composed of tinned iron wire, which is known to be of greater tenacity than metal that has not been subjected to the process of drawing, and also to be far lighter, as well as stronger, in proportion to the weight employed, than any other material, the interstices between the several rounds of the wire serving for the escape of the water; the different speeds required are also obtained gradually, by means of the differential cones shown in the engraving. The difficulties in the way of the perfect success of this method of drying being now completely overcome, a machine worked by manual power alone, will produce a greater effect than could heretofore be procured by even steam or water power. In the domestic operation of drying clothes, the great advantages of this method will be at once acknowledged by all who witnessed it. It is well known to those having the management of this important item in domestic economy, that the destruction of clothes from wringing, or squeezing, after washing (the methods now generally adopted,) is often greater than even from the natural wear of the same. The improved machine entirely puts an end to this mischief; the clothes being placed with all the water in them directly therein, and after two or three minutes working, taken out nearly dry, without having been subject to the least strain on their fibres; indeed, the finest materials, such as silk gauzes, crapes, or fine muslins, on being taken out, do not show the least displacement in their texture. For manufacturing purposes, its advantages are equally great. In many places where it has been adopted, it is already in some processes of finishing, considered indispensable. It would far exceed the limits of this paper to point out all the advantages of this machine, in the various and numerous drying operations that the endless variety of materials now finished in our manufactures, go through; only a few of the most obvious advantages will here be adverted to.

First, the goods are not injured in the slightest degree; the only pressure or other force to which they are subjected, is that of the different folds of the goods upon each other by virtue of their centrifugal tendency; and this, even in the finest and most delicate material, does not produce the slightest abrasion in the texture, or rupture in the threads; at the same time all creases are entirely avoided, and in the case of very fine yarns of silk or cotton, the difficulty that arises from the adhesion of their fibres after wringing, or other pressure, is completely prevented.

Secondly, the liquid, or moisture, is so completely and so uniformly abstracted by this process, however heavy the fabric, that only a very slight degree of heat and time are required to complete the drying, and in most cases, the goods are sufficiently dry for the finishing process, and in consequence of less heat being required for drying, the injury so frequently occasioned to the colours, and also to the fabric, is thus avoided.

Thirdly, in the finishing process, when a certain and determinate quantity of moisture, starch, soap, or other article, is desired to be left in the goods, the quantity of such article can be fixed with an equality and exactness not otherwise attainable, the machine being so arranged that the speed, and therefore the effect, can be regulated and altered at pleasure from 200 to 2000 revolutions per minute.

Fourthly, in some dyeing processes, where expensive materials are employed, a considerable saving has been effected, as a larger quantity of such material can be extracted by this, than any other process; and in the finishing process, where fancy or fugitive colours are employed on heavy articles, a regularity of colour is obtained in the drying that could not previously be had.

The machines are calculated to hold from 100 lbs. to 300 lbs. of wet goods, and any lesser weight to a single pound can be operated upon with equal advantage. The machines to work by manual power, are made principally for use in Hospitals, Asylums, Union Workhouses, and domestic, and other establishments, in which steam or water power is not usually to be had. They are constructed to hold about six pair of sheets at once, or any quantity of smaller articles of similar bulk, and the time required for the operation is not in any case more than five minutes.

*Note* A.

This effect may be deduced from original principles in the following manner:—Every body in motion, if left to itself, will continue to move in the right line, of which its past path is a part. If this path is to be made to take another direction, it will require some force to do it; the amount of that force will depend partly on the weight of the body, partly on the degree at which the new path deviates from the old one, and partly on the speed at which the change must be effected. The investigation by which the application of these principles is made to produce practical results, may be found in all the best treatises on mechanical science; we mention only *Simson's Fluxions*, *Art.* 211; *Gregory's Mechanics*, Book 2, Class 3; *Barlow's Math. Dict.*, Art. "*Central Forces*;" *Young's Natural Phil.*, vol. ii. p. 80; *Moseley's Mechanical Principles of Engineering and Architecture*, Art. 121. The most convenient form, for general purposes, to which the principal results of the investigation can be reduced, is $K = W \frac{V^2}{32\,R}$ in which K stands for the centrifugal force, W for the weight of the body, V for the velocity in feet per second at which the body is revolving in the circle, and R for the radius in feet of the circle in which the body revolves. For the present purpose, let $n$ represent the number of turns per minute, and the formula reduces to $K = 0{\cdot}000342694\ n^2\ R$, by which the table on the opposite page was calculated. It will be observed that in the table diameters are given, as being for its purpose more convenient than radii, which are inserted in the formula.

| Diameter in Feet. | Number of Revolutions per minute. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 100 | 250 | 500 | 750 | 1000 | 1250 | 1500 | 1750 | 2000 |
| 2 | 3·4269 | 21·418 | 85·673 | 192·766 | 342·694 | 535·46 | 771·063 | 1049·5 | 1370·776 |
| 2½ | 4·283[illegible] | 26·772 | 107·091 | 240·957 | 428·367 | 669·324 | 963·829 | 1311·875 | 1713·47 |
| 3 | 5·1403 | 32·127 | 128·506 | 289·149 | 514·040 | 803·189 | 1156·595 | 1574·25 | 2056·164 |
| 3½ | 5·9970 | 37·481 | 149·927 | 337·340 | 599·713 | 937·054 | 1349·361 | 1836·625 | 2398·858 |
| 4 | 6·8530 | 42·836 | 171·346 | 385·532 | 685·388 | 1070·92 | 1542·126 | 2099·9 | 2741·552 |
| 4½ | 7·7105 | 48·190 | 192·764 | 433·723 | 771·061 | 1204·785 | 1734·892 | 2361·37 | 3084·246 |
| 5 | 8·5672 | 53·545 | 214·182 | 481·915 | 856·734 | 1338 650 | 1927·658 | 2623·75 | 3426·94 |
| 5½ | 9·4239 | 58·899 | 235·600 | 530·106 | 942·407 | 1472 515 | 2120·424 | 2886·125 | 3769·634 |
| 6 | 10·2807 | 64·254 | 257·019 | 578·298 | 1028·082 | 1606·38 | 2313·189 | 3148·5 | 4112·528 |
| 6½ | 11·1374 | 69·608 | 278·437 | 626·489 | 1113·755 | 1740·245 | 2505·955 | 3410 875 | 4455·022 |
| | Number of times the Outward Pressure, or Centrifugal Force exceeds the Weight. | | | | | | | | |

*Note* B.

From the experiments of M. Morin, as quoted by Professor Moseley, *Mech. Princ.*, p. 154, it appears that axles of iron, in brass bearings, greasy and wetted, (which

would be the materials and state of these) have a friction equal to the insistent weight multiplied by 0·19. The journals of a shaft to bear 1542 lbs., and exposed to the risk of a greater load, could not be less than one and a half-inch in diameter. *Tredgold on Cast Iron*, (1824) p. 169. From these and the remaining well-known data, we get

$$\frac{1542 \times 0{\cdot}19 \times \Pi \times 1\tfrac{1}{2} \times 1500}{12 \times 33000.} = 5{\cdot}23.\ \text{H. P.}$$

for the power required to overcome the friction under the circumstances described above. The power thus wasted is proportioned to the fourth power of the number of turns per minute, for it is as the square of that number for the centrifugal force, as the square root of that square (that is, as the number of turns) for the diameter of the journal, and as the number of revolutions for the velocity of the resistance. It is easy to see how rapidly the waste of power increases in comparison with velocity, and why, in the absence of all contrivance to obviate that waste, it was necessary to be content with slow velocities and imperfect effects.

### QUESTIONS IN COOLING.

Sir,—You will much oblige a Subscriber to your most useful Journal by publishing the following queries, and requesting the necessary information from any of your scientific correspondents.

Can ice be cooled down below the freezing point by being surrounded with freezing mixtures which are capable of cooling much below that point? We know that water can be cooled several degrees below 32° without freezing, but that at the moment of congelation its temperature rises to that point. Does ice, then, always retain this temperature of 32°, or does it afterwards fall to the temperature of the surrounding atmosphere which, say, may be at zero? And if a block of ice, such as we get from America, may be capable of becoming cooled down to zero, what process takes place while it is melting away in a temperature above the freezing point? Does the whole mass, in the first instance, gradually acquire the temperature of 32° before it begins to liquefy, or is the surface alone affected by the heat of the surrounding atmosphere, and liquefied, while the core retains the degree of cold which it may have originally acquired? In other words, can some ice be colder than other ice, and will such ice take a longer time to melt (the masses being equal) than the latter, when both are exposed to the same temperature? The confectioners, I am aware, increase the freezing power of ice by mixing it with common salt; but the effect of this process may be on the material, such as cream, and not on the ice itself. The salt, I believe, causes the ice to melt more rapidly, and, consequently, there is a more rapid absorption of caloric from the material which is placed in contact with the melting body, as all bodies in passing from a solid to a fluid state absorb caloric. Is it not, therefore, that the cream is sooner frozen by employing a mixture of ice or snow, and salt, rather than the ice or snow is reduced in temperature by the admixture? I am, sir, yours, &c.,

TYRO.

### SWEDENBORG AS A MAN OF SCIENCE—DISCOVERED THE SEVENTH PLANET BEFORE HERSCHEL, THE COMPOSITION OF WATER BEFORE CAVENDISH, THE RESPIRATORY MOTION OF THE BRAIN BEFORE SCHLICHTING, ETC.

The *New York Herald* contains a report of a very remarkable address delivered by Professor Bush, at the New York University, "On the scientific character of Swedenborg"—a name only hitherto known in connection with mysticism of the dreamiest and wildest description, but which now seems destined to go down to future ages as that of one of the sagest philosophers, and most original thinkers of his time. We extract some of the more striking passages:—

The name of Emanuel Swedenborg is seldom associated with scientific labours, because he is little known but as the reputed founder of a religious sect; and one, too, which usually receives but little credit on the score of that soundness of intellectual vision which would be apt to be reflected upon it by the influence of a profoundly philosophical leader of their faith. As the system they have embraced is for the most part accounted a strange medley of phantasies and fictions, this system has been made the standard by which to judge of the character of its promulgator; and tried by such a standard, it could hardly be supposed that we were to look to this source for any striking exhibition of the attributes of a strictly scientific mind.... The evidence which is constantly accumulating in regard to the scientific career of Swedenborg is such as to produce the most profound impression upon the world. Its amazement at the intrinsic amount and value of his discoveries is only to be equalled by that excited by the fact that they have so long remained in obscurity.....There is no longer anything apocryphal in this matter. We are not shut up to mere hearsay report

on the subject. The scientific character of this illustrious man does not rest upon a mere vague rumour, bruited mainly by his followers, that there exists, locked up in the recesses of the Latin tongue, a vast treasury of valuable writings on various subjects of physical research, but to which all ordinary access is precluded..... Swedenborg commenced his career as a practical mechanician and engineer, having laid a foundation in the deepest study of mathematics and general physics. One of his earliest publications was a treatise on algebra, which was soon followed by various works on mechanics, both in their theoretical principles and their practical application. In 1718, at the age of thirty, he appears as the inventor of a mode of transporting galleys across mountainous countries, on rolling machines, to a distance of fourteen miles, under cover of which, at the siege of Frickershall, the royal artillery was brought to bear upon the walls of the city. During the few years succeeding, he published a vast variety of works on physical science, the very titles of which fill one with astonishment at the universality of his powers; but the whole was crowned by the publication, in 1734, of the *Opera Philosophica et Mineralia*, or Philosophical and Mineral Works, in 3 vols. folio, illustrated with a vast number of engravings, and embracing the result of the profoundest researches into the domains of nature, from her primordial elements to her grandest organic phenomena. The first part is entitled, *Principia, or New Attempts at a Philosophical Explanation of the Phenomena of the Elementary World.* This has recently been translated into English, and published in two volumes, presenting to the world a monument of genius worthy to stand by the immortal *Principia* of Newton.....

A large part of this work is devoted to the subject of terrestrial magnetism; and in this department very little advance has been made beyond the points which Swedenborg reached.... It does not consist with the objects of a popular lecture, to go into the details of any philosophical system; but it may be proper to state, in general, that Swedenborg makes the magnetic element the agency which controls the planetary movements. In other words he resolves the power of gravitation into magnetism, and shows, moreover, that precisely the same laws which govern a single particle of matter in its properties of motion, govern also all the heavenly bodies in their orbitual revolutions. .. .. ..

As to the prominence given to geometry, in his physical researches, the ground of it may be seen in the following extract:—"Elementary nature is a motive power, variously modified. A motive power, variously modified, is a system of mechanism; a system of mechanism is geometry in action; for it must needs be geometrical. Geometry is the attribute of substance, possessing figure, and occupying space; and as geometry is inseparable from every substance, whether simple or compound, both in motion and rest, it accompanies nature from its first origin and rudiments, from its least form to its greatest, through the whole extent of creation. And as geometry is the same in the greatest substances and in the least, hence, nature being a motive and modified power, being mechanical and geometrical, is exactly like herself in each extreme of smallness or greatness." The grounds of this, in one direction, may be seen in the process of crystallization; as, for instance, in the snowflake, where all the forms are geometrical; and in the other, on a larger scale, in the balsaltic column, where the same principle holds. * * * Prior to the period of the publication of his great work on the mineral kingdom, to which I have just alluded, his amazingly fertile pen had given to the world an immense multitude of works on nearly every subject of human knowledge. He wrote upon mechanics, mathematics, astronomy, chemistry, finance, ship-building and geology, and upon all these subjects showed himself a master..... He applied the whole force of his mind to penetrate into the most hidden things—to connect together the scattered links of the great chain of universal being, and to trace up everything, in an order agreeable to its nature, to the first great Cause.....Having sounded the depths of the mineral kingdom, to which his attention was doubtless first turned by his official duties as assessor of the mines of Sweden, he now made his *entré* into the animal realm, and anatomy and physiology became his absorbing themes..... Satisfied that all animal organization and economy was the immediate product of the informing life, or soul, his aim was continually to compass the nature of this mysterious power..... It is utterly impossible to give any adequate view of the gigantic grasp of intellect apparent in his works on this subject, or of the immense value of his reasonings and conclusions founded on the various structures of the human organism.....And be it remembered, that the work was written by an amateur physiologist, who came to the study when past the age of forty; whose previous life had been devoted to mechanics, mathematics, astronomy, and general physics, and who was prompted to it by no motive of gain or professional *eclat*. Yet this man has left all competitors behind him, in a field illustrated by the genius of Haller,

Boerhave, Swammerdam, and a host of distinguished names of later times, whose whole lives were spent in the arena. The progress of the science up to this day has been a continual course of confirmation of the grand principles laid down by Swedenborg..... And now it will be proper to advert to some of his splendid anticipations of the discoveries of modern times. To say nothing of the fact that his great work on the mineral kingdom contains the germ of the sublime system of geological science, which stands forth so prominent at the present day, we come to other announcements of a perfectly unequivocal character. In 1781, Herschel proclaimed to the world the discovery of a seventh planet in the solar system. Swedenborg, as early as 1745, in his work, entitled, "Divine Love and Worship," in which he gives an account of the creation, expressly says, there were seven planets produced from the sun, "which revolves in the grand circus of the world—each of which being balanced in its sphere, according to the proportion of its size with its weight, receded by a quicker or slower pace from its natal centre." Another was the anatomical discovery of the passage or communication between the right and left ventricles of the *cerebrum*, usually termed the *foramen of Munro*, from the fact that the discovery was claimed by Dr. Munro, of Edinburgh, in 1753. Now this very foramen, or check, is specifically mentioned and described in the "Animal Kingdom of Swedenborg," published in 1745, nine years previous to the date of Dr. M.'s alleged discovery. The respiratory motion of the brain is still another discovery, clearly traceable to Swedenborg. Blumenbach, the German physiologist, speaks of this discovery, and attributes it to Dan Schlichting. But the fact is fully described in Gurd's "Economy of the Animal Kingdom," which was published before Schlichting wrote. The discovery amounts to this:—That when the lungs shrink or empty themselves in expiration, the brain rises; but when they swell or expand themselves in inspiration, the brain sinks. This fact of the respiratory motion, or alternate swell and subsidence of the brain, is now universally admitted. Yet, Swedenborg was the first that announced it. So, again, as to the composition of water. Swedenborg laid this down geometrically, stating the chemical equivalents of its components to be of the value of eight and one, always calling water nine, which is the formula of the present day. This was claimed as the discovery of the French chemist, Lavoisier, but Swedenborg gave it forth to the world long before. We may here also advert to the fact, that so far as there is any truth in the modern science of phrenology, the authorship of which is ascribed to Gall and Spurzheim, it is found propounded not only in its general principles, but even in its specific details, in the cerebral physiology of Swedenborg..... And as to what is termed the science of mesmerism, or animal magnetism, I shall hope to show, in another lecture, that not only are all its grand phenomena detailed by Swedenborg, but that they are all adequately accounted for on the soundest psychological principles..... If it was said of Goldsmith by Johnson, in his epitaph, that he left no subject of human knowledge untouched, and never touched any subject that he did not adorn; how much more applicable is the sentiment to the illustrious Swedenborg?..... It is indeed a rare spectacle to behold the same individual at home in the furnaces and workshops of the mines, delving into the composition of ores and superintending the smelting processes, and anon soaring to the stars and unfolding the laws of planetary motion—at one time, as it were, forging bolts with the Cyclops in their caverns, and then mounting with Phaeton the chariot of the sun—now gauging the measures or directing the construction of ships, and now wielding the abstrusest formulæ of the algebraic calculus—now planning a machine, and now showing how the world was formed—now experimenting with the magnet, and now proposing the best system of regulating the commerce of the realm—now penetrating the profoundest subtleties of metaphysics, and now exploring the structural organism of the animal kingdom, and that with a power of analysis and a precision and depth of reasoning which has left all competition at least a century behind.

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## AMERICAN TRIBUTE TO THE MEMORY OF THE LATE GEORGE CRANE, THE FOUNDER OF THE ANTHRACITE IRON MANUFACTURE. *

George Crane, Esq., the founder of the Anthracite Iron manufacture, died at his residence near Swansea, South Wales, on the 10th of January, 1846, in the 62nd year of his age. Mr. Crane was a native of Broomsgrove, Worcestershire, and for fifteen years was engaged in the hardware business in Birmingham, from which he retired about the year 1820, with no intention of again engaging in business; but, becoming tired of an idle life, he visited Wales in 1823,

* By Mr. Solomon W. Roberts, C.E. Extracted from the Franklin Journal, for March 1846.

and commenced making iron at the Ynisced-win works, which then consisted of one small blast furnace. Those works are situated in Breconshire, in the picturesque valley of the Tawy, a small river which flows into the Bristol channel at Swansea, and they are thirteen miles from that port. When Mr. Crane took charge of them, and for a long time after, the smelting of the iron ore found in the vicinity was carried on with coke made from bituminous coal; but as an extensive field of anthracite coal existed in the neighbourhood, which was considered useless for smelting purposes, his attention was early turned to the importance of bringing that fuel into use; and at different periods, during fourteen years, he had at a large outlay, tried a variety of plans to effect the object.

Though repeatedly baffled he still persevered, and his efforts at length were crowned with complete success. Finding that the use of this hard and refractory fuel caused his furnace to chill, he resolved to try the effect of heating the blast to a temperature sufficient to melt lead, upon the plan so successfully introduced by Mr. Nielson, for increasing the yield of furnaces worked with bituminous coal. — Having made the necessary preparations, he began the experiment with the hot-blast on the 7th of February, 1837, in a furnace forty-one feet high and eleven feet in diameter at the boshes. From that date until the 12th of March the furnace was worked with roasted anthracite as the only fuel, and thenceforward exclusively with raw anthracite as it came from the mine without any preliminary preparation. In all respects Mr. Crane's success was complete; his furnace worked well, the yield was better than with coke, and the iron was of superior quality. He felt that the problem to which so many experimenters had turned their attention, both in Europe and America, and to which he had devoted so much of his time, was triumphantly solved. He had accomplished the object on an extensive working scale, with continued and increasing success; and from this period dates the establishment of a new and important manufacture, from which the iron trade, both of Great Britain and the United States, is now deriving great advantages. The writer of this notice, who was at that time sojourning among the iron works in Wales, visited Mr. Crane's establishment in May, 1837, for the purpose of seeing the process and of satisfying himself that the materials used were similar to those which exist so abundantly in Pennsylvania. Finding that the great object was accomplished, and that the results were highly gratifying, he communicated the fact to his friends in Philadelphia, by whom it was shortly after made public through the newspapers. At that time there was no blast furnace in Pennsylvania working with anthracite coal; their number in the State is now twenty-seven, and there are several in New Jersey.

At the meeting of the British Association for the Advancement of Science, held in Liverpool, in September, 1837, Mr. Crane attended and presented a paper descriptive of his process, which is printed in the sixth volume of the proceedings of that association. He had secured a patent in Great Britain and had applied for one in the United States, the issue of which was for some time delayed, owing to obstacles which grew out of the premature publication of his process. When great difficulties have been overcome by simple means men are prone to depreciate the inventor, and in proportion to the number of the individuals and to the importance of the interests benefited, is the pertinacity with which his claims are contested. After he has made plain a path before untrodden, his merits are questioned as those of Columbus were by the Spanish courtier, whom the great Genoese so keenly rebuked by placing an egg on its end. Mr. Crane's case formed no exception to this general rule. His patent was infringed, and he became involved in a tedious and expensive litigation which some of his friends feared might end in his ruin. At length, however, the question as to the validity of his British patent was decided in his favour, and thenceforward it became a source of much profit to him. He extended his works at Ynisced-win by the erection of several additional furnaces, and his concerns became highly prosperous. The validity of his patent in the United States has not been tested, although his process is extensively used. He consulted the writer of this notice as to the expediency of entering into litigation on the subject in this country; who in reply compared the case of Mr. Crane to that of Eli Whitney, the inventor of the cotton gin, the value of whose invention to the public made it the source of such vexation to the patentee. Mr. Crane is undoubtedly entitled to the honour of being the first to establish the smelting of iron with anthracite coal. At the time he succeeded, the business did not exist, and ever since it has gone on increasing. In testimony of this, the important works of the Lehigh Crane Iron Company have been named after him, which were erected and are carried on under the able superintendence of Mr. David Thomas, who was sent out from Wales by Mr. Crane for that purpose.

Having lived long enough to see the object on which his heart was set completely accomplished, Mr. Crane died suddenly from the effects of a painful accident. Being somewhat indisposed, he had received two small bottles containing medical prescriptions, one intended to be used internally and the other as a liniment; and, by mistake, on the night of the 8th of January last, he accidentally took the contents of the wrong bottle, which produced inflammation of the stomach and carried him off in two days, notwithstanding the best medical aid. —He was a man of great excellence and purity of character, warmly attached to the Episcopal church, but liberal to those of different opinions. He was a friend to the poor, and active in visiting and relieving the sick. He always provided for the widows and orphans of his workmen, and saw that their orphan children were educated.— His active exertions to promote the general welfare and the moral and religious improvement of those in his service, furnish a bright example for the imitation of other iron-masters. He died unmarried, but hundreds who were employed by him lament his loss as that of a father. He felt a lively interest in the preservation of peaceful relations between Great Britain and the United States, and took great pleasure in hearing of American prosperity. We have reason to trust that his spirit has passed from works unto rewards in a better and more enduring country.

Philadelphia, March 4, 1846.

## RECENT AMERICAN PATENTS.

[From Mr. Keller's Abstracts in the *Franklin Journal.*]

For an Improvement in the Mode of Dredging the Channels of Rivers. —*Henry McCarty.*—The nature and object of this improvement is fully pointed out in the following

*Claim.*—"What I claim as my invention is the before-described mode of scraping the bottoms of rivers, by operating a floating scoop by power machinery, placed in a separate vessel, anchored on the opposite side of the river, the said floating scoop being attached to an anchor up stream, so that the current will carry back the scoop to the opposite side of the river at the termination of every operation of the said scoop, for a repetition of the action of the scoop; the vessel containing the engine being moved up or down stream as the work progresses by the power of the engine as described."

For an Improvement in Carriage Wheels.—*Eliphalet S. Scripture.*—The object of this improvement is to arrange the spokes and hub in such manner as to afford a ready means of tightening the wheel when the spokes become loose by shrinking, which is effected by inclining the spokes either way from the plane of the wheel to form what is termed a double dished wheel, one half of the spokes being inserted in a permanent hub or cheek piece, and the other half in a movable hub, or cheek piece, which slides on the pipe box, so that by means of a nut the movable hut can be forced with its spokes towards the other, and thus tighten the spokes.

*Claim.*—"Having thus fully described my improvement, I wish it to be understood that I do not claim constructing wheels with the spokes bracing by projecting the inner ends out from the plane of the wheels on each side; nor do I claim screwing the ends up firmly against a centre permanent projection on the hub, as that would not effect the object I have in view, which is to continually tighten the spokes, and brace them out against the felloes as they wear loose; but what I do claim is the combination of the pipe box with the cheek pieces into which the spokes are inserted, and fastened by plates on their outside, a space between the said cheeks being left so that they can be forced towards each other to tighten the spokes as they wear loose, or shrink, and by that means firmly brace the wheel, which can be readily taken to pieces, and any broken or defective parts replaced by perfect ones."

For an Improvement in the Connecting Rods for connecting the Crank Pins of three or more driving Wheels of Locomotives.—*Holmes Hinckley.*—The object of this improvement is to connect three, four, or more, driving wheels with a single connecting rod, and permit those between the two end ones to have a vertical and lateral play, which is effected by having the crank pins of the intermediate wheels work in boxes that slide vertically in the connecting rods, the said crank pins being made of sufficient length to give end play to the axles.

*Claim.*—"I claim making the boxes to slide vertically in the connecting rod, in combination with extending or lengthening the crank pins of the wheels beyond the said boxes, so as to slide through them in the direction of their axes, as set forth; the whole being for the purpose of converting all of the several wheels of the engine into drivers as described."

For Improvements in the Printing Press.—*Joel G. Northrup.*—The patentee says, "In my press I employ four friskets, which are made to traverse up and down,

being governed in their movements by suitable guides, and carried by pinions and ratchets, to be presently described. In their passage, two of them are simultaneously brought opposite to two forms of type situated vertically, between which and two platens they are arrested during the period necessary for taking the impression; the platens being brought up against them by a revolving shaft, furnished with arms, carrying friction rollers, and the impressions are thereby taken; at this time one of the friskets is situated above the platens, and the other below them; that above opening for the delivery of a perfected, and the feeding in of a blank-sheet."

*Claim.*—"I do not claim the using of four friskets as in itself new, but I claim the manner and combination in which I use them, which are necessarily different from any heretofore adopted; and these I claim whether the form, or forms, of type be placed vertically or horizontally, and whether two impressions, or only one, be taken at the same time.

"I also claim the manner of combining and arranging the parts by which the power is applied to the platens, through the intermedium of the revolving shaft, which is made to operate intermittingly, and to carry arms that bear upon the backs of the platens, as herein set forth."

AN IMPROVEMENT IN DOOR LOCKS.—*John Oxnard.*—The tumblers of this lock when bolted, or unbolted, rest on the periphery of a metal block, which is turned by a spindle. A portion of the periphery of this block is cut out, and a hole is made through the face for the insertion of a bit plate adapted to the proper movement to be given to the tumblers when carried round by the turning of the block, this apparatus answering the purpose of a key to increase the difficulty of picking.

*Claim.*—"Having therefore described my improvements, I shall claim the revolving block and bit plate as applied to each other and to the bolt, and operating upon the bolt through a spring lever or other suitable contrivance connected to the bolt, the whole being substantially as herein above set forth."

EXTRACT OF QUERCITRON BARK, CALLED "FLAVINE," WHICH CONTAINS THE YELLOW COLOURING MATTER, AND ALSO THE ASTRINGENT PORTION OF THE SAID BARK.—*George Close and Edward Field.*

*Claim.*—"We wish it to be understood that we do not claim extracting the tannin from the colouring matter in quercitron bark, as that has before been done by the introduction of gelatine, by which it is separated; but what we do claim as our invention, is the process of evaporating the yellow colouring matter and tannin, or astringent matter of quercitron bark, substantially as here described; that is to say, by partially evaporating the decoction and then allowing the colouring matter to settle, and then drawing off the astringent liquid and preparing it for the uses intended."

IMPROVED MODE OF DRESSING LEATHER.—*William A. Ronald* and *Henry Miller.*—The patentees say—"The nature of our invention consists of a new mixture which we apply to the leather; the mixture is made by boiling together oil, bees-wax, tar, and resin-soap in the following proportions, viz.: to every half-gallon of oil, add 1 quart of tar, 4 ounces of bees-wax, and 4 ounces of resin-soap.

*Claim.*—"What we claim as our invention is *not* the employment of a composition of bees'-wax, oil, or tallow and tar for dressing leather, these having been a long time in use; what we *do* claim is the employment of resin-soap in combination with the articles specified. The advantages resulting from this new ingredient in the composition, is the saving of time and money, as the work can be sooner accomplished, and as there will be a saving of all the tallow heretofore used, and that the employment of the resin-soap has a tendency to make the surface of the leather more smooth, and that it renders it more impervious to snow, mud, and water."

## SCREW PROPELLING—LOWE v. PENN.

At the trial of this case above a twelvemonth back, before the Court of Queen's Bench, a verdict was found for the plaintiff, which we ventured at the time to say, was "contrary to evidence and to fact." (See *Mech. Mag.*, vol. xlii. p. 448.) On a subsequent occasion a rule was obtained calling upon the plaintiff to show cause why the verdict should not be set aside and a new trial granted, upon the ground that there had not been any infringement of the patent, and that the patent itself was void, as the subject matter of it was not new.

The case having been accordingly fully re-argued, Lord Denman, on Tuesday last, delivered the judgment of the Court upon it.

His lordship, having stated the general nature of the case, observed that the plaintiff himself did not contend that the parts of the invention were new, but only that they were placed in a novel combination. Having reviewed and compared all the circumstances of the description as contained in the specification, his lordship observed, that the Court was of opinion that the invention which was the subject of the patent was not new, and that the rule for a new trial ought to be therefore made absolute.

H.M.Y. "FAIRY"—COMMANDER HOSEASON IN REPLY TO MR. PENN.

Sir,—The word "burst" which is objected to by Mr. Penn, was not used by me in the sense in which it is evident he has taken it. I used burst in the sense of *given out*, and never intended it to signify that the boiler of the *Fairy* had blown up or exploded; indeed I hardly dwelt upon the matter at all, further than to prove that the boiler was placed *hors de combat*, and rendered for the time useless. I feel myself fully justified in having used it in that sense, from having read hundreds of similar accidents described in the same manner. We say at sea a leak burst out on board such a ship, but nobody would for an instant understand, that an assertion of such a fact, unaccompanied by any further observation, would convey an idea of a force having been exerted to cause it. Remember, I only commented upon the load upon the *Fairy's* valve with a view to show the extreme absurdity of talking of the nominal horses power instead of the *real* power, as a standard of the true test of the force put forth by an engine; and by no means can I be supposed to find fault with the weight upon the valve, as I beg Mr. Penn to understand that I am a warm advocate, and ever have been, for a far greater load than that placed upon the valve of the *Fairy*. I am, &c.,

J. C. HOSEASON.

Army and Navy Club, May 26, 1846.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65.

| Date of Registration. | No. in the Register. | Proprietors' Names. | Address. | Subject of Design. |
|---|---|---|---|---|
| April 27 | 706 | William Coulbourne, of the firm of Ward, Colborn and Gillett, | Stratford-on-Avon, agricultural implement maker | Hand-seed depositor. |
| 29 | 707 | S. Wertheimer and P. Simon | 35, Greek-street, Soho | Improved pamphlet and leaf-holder. |
| May 1 | 708 | Alexander Alexander, | 6, High-street, Exeter, Devon | Portable levelling staff. |
| 6 | 709 | Henry Field | Argyll-street, Glasgow | Wind guard. |
| 7 | 710 | Thomas Empson | 32, King Edward-place, Birmingham, button manufacturer | Victoria fastening for ladies' dresses. |
| 8 | 711 | Chilton and Taverner, | 135, Old-street | Back of a sewn-through button. |
| ,, | 712 | William Mosely | 17, New-street, Saint Martin's-lane | Apparatus for giving motion to a drill. |
| 9 | 713 | Edmund George Hummel, and Horace Morley Hummel | 6, Old Bond-street | Symmetrical shirt. |
| ,, | 714 | W. Palmer | Brighton, ironmonger | Percolator. |
| 12 | 715 | Thomas White | 24, Cornhill, London, chemist and druggist | Improved metallic shield for the prevention and cure of sore nipples. |
| 13 | 716 | Edward Bird | Birmingham | Lamp. |
| 14 | 717 | Edward Bird | Birmingham | Vessel for a lamp. |
| 15 | 718 | George David and James Doudney | 17, Old-street, Hanover-square, Westminster, tailors | Configuration and arrangement of a combination of bands or cords as applied to the waists of trousers, &c., by which such garments are enlarged or contracted at pleasure. |
| 16 | 719 | Green and Bentley | 27, Upper George-st. Bryanstone-square, London | Chimney protector. |
| 20 | 720 | Robert William Metham | 21, Beresford-terrace, Walworth | Bonnet preserver. |
| ,, | 721 | James Black | Brown-street-lane, Edinburgh, machine and press maker | Machine for cutting paper, pasteboard, &c. |
| 21 | 722 | James Taylor | The Vinegar Works, Long-lane, Southwark, London | Atmospheric railway valve. |
| ,, | 723 | Isaac Churchyard | 24, Park-terrace, Regent's-park. | Tooth brush. |
| ,, | 724 | James Alex. Forsett | Liverpool, glass manufacturer | Window ventilator. |
| ,, | 725 | John Ingledew | Brighton, miller | Angle coupling to be used in carpentry and cabinet-making. |
| 25 | 726 | John Wellstead and Thomas Bray | 103, Saint John's-wood-terrace, Saint John's-wood | Anti-emergent rat-trap. |

LIST OF ENGLISH PATENTS GRANTEDBE TWEEN APRIL 28 AND MAY 26.

William Edward Newton, of Chancery-lane, civil engineer, for certain improvements in clocks or time keepers. (Being a communication.) April 28; six months.

Samuel Pickford, of Stockport, glass dealer, for certain improved apparatus applicable to casks or vessels for preserving ale and other fermented liquors, and also for raising or forcing the same for draught. April 28; six months.

Isaac Henry Robert Mott, of 76, Strand, for certain improvements in musical instruments, whereby they are rendered much more durable, much more

capable of resisting the injurious and destructive effects of the atmosphere, (especially of extreme climates,) and whereby the quality of their tone is greatly improved and remains good for a much longer period. April 28; six months.

William Higgs, of Westminster, chemist, for the means of collecting the contents of sewers and drains in cities, towns, and villages, and for treating chemically the same, and applying such contents when so treated to agricultural and other useful purposes. April 28; six months.

Anthony Nathan de Rothschild, of London, merchant, for improvements in heating apparatus and buildings. (Being a communication.) April 28; six months.

William Mather, of Salford, near Manchester, and Colin Mather, of the same place, millwrights and engineers, for improvements in metallic pistons. April 28; six months.

Charles de Bergue, of Arthur-street west, London, engineer, for improvements in atmospheric railways. April 28; six months.

James Timmins Chance, Handsworth, Stafford, glass manufacturer, and Henry Badger, of West Bromwich, glass stainer, for improvements in the manufacture of glass. April 28; six months.

Joseph Douglas, of Newcastle-upon-Tyne, rope-maker, for improvements in the manufacture of yarn, twine, and cordage. April 30; six months.

Joseph Touche, mechanist, of Rue St. Antoine, Paris, for improvements in lamps. April 30; six months.

Edward Augustin King, of Warwick-street, Charing Cross, Middlesex, gentleman, for improvements in the production of magnetic electricity. (Being a communication.) April 30; six months.

Thomas Lambert, of New Cut, Blackfriars, brass founder, and Charles William Rowley Richards, of Charlotte-street, Blackfriars, engineer, for improvements in cocks for drawing off liquids and gases. April 30; six months.

John Mercer, of Oakenshaw, Clayton le Moors, Lancashire, chemist, for certain improvements in scouring and clearing wool and woollen fabrics, also in bleaching and clearing silk, cotton, and linen, and other fabrics. May 2; six months.

George Palliser, of Finsbury-place, for improvements in the construction of outside seats of carriages. May 5; six months.

William Longshaw, of Manchester, for certain improvements in machinery or apparatus for spinning and doubling cotton and other fibrous substances. May 5; six months.

Peter Carmichael, manager for Baxter Brothers and Co., Dundee, for improvements in heckling or dressing flax, hemp, and other fibrous substances, and improvements in machinery for rubbing, stretching, and equalizing the breadth of cloth made from flax, hemp, jute, and other fibrous substances. May 5; six months.

George Riddett, of Ryde, Isle of Wight, upholsterer, for improvements in reading-tables. May 5; six months.

John Carter, of Fleur-de-lis-street, London, ivory merchant, for improvements in paddle-wheels. May 5; six months.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for certain improvements in machinery for manufacturing screws. (Being a communication.) May 5; six months.

William Church, of Birmingham, for certain improvements in machinery, to be used in making candlestick pans, and various other articles which are usually produced wholly or in part by means of the process called stamping; and also in machinery for making sockets or tubes for candlesticks and tubes, or tubular articles applicable to various other purposes. May 5; six months.

William Pidding, of Wigmore-street, gentleman, for an improved process for preserving the flavour of coffee and cocoa, or of any preparations thereof, from the effects of the atmosphere. May 5; six months.

Thomas Melling, of the firm of Melling and Co., Rainhill, Lancashire, engineers, for certain improvements in steam engines, marine, stationary, and locomotive; and in machinery and apparatus connected therewith, parts of which are also applicable to regulating the flow of fluids generally. May 7: six months.

Edward Shepard, of Trafalgar-square, gent., for certain improvements in gates, doors, shutters, and other articles of the like construction, and in fastenings to be attached thereto. May 7; six months.

Mark Rollinson, of Brierly-hill, near Dudley, engineer, for certain improvements in steam-engines. May 7; six months.

Alexander Angus Croll, of Suffolk-street, Clerkenwell, chemist, for improvements in gas meters. May 12; six months.

William Little, of 198, Strand, publisher of the *Illustrated London News*, for improvements in machinery for printing. May 12; six months.

John Lloyd Bullock, of Conduit-street, Hanover-square, chemist, for improvements in the manufacture of quinine. (Being a communication.) May 12; six months.

Robert William Sievier, of Upper Holloway, gent., for improvements in printing. May 13; six months.

Christopher Vaux, of Frederick-street, London, gent., for improvements in apparatus employed in transmitting and drawing beer and ale. May 13; six months.

Charles Hancock, of Grosvenor-place, gent., for certain improvements in the manufacture of gutta percha and its applications, alone, and in combination with other substances. May 15; six months.

Henry Valentine Bartlett, of Sheffield, dentist, for improvements in artificial palates, teeth, and gums, and certain machinery employed in the manufacture thereof. May 15; six months.

Julius Jeffreys, of Norfolk-crescent, Hyde-park, gent., for improvements in steam-engine boilers and furnaces, and improvements in propelling vessels. May 16; six months.

William Rodger, of Shamfield-street, Chelsea, Lieutenant R. N., for improvements in anchors. May 18; six months.

George Duncan, engineer, Edinburgh, for an improved method of making comfits, confectionary, lozenges, and all descriptions of pan-goods, the machinery and apparatus for the manufacture of the same, or for any other article to which the said apparatus or machinery may be made applicable. May 19; six months.

Stephen Perry, of Woodland-place, St. John's-wood, gent., for certain improvements in the manufacture of rings, straps, bands and bandages, cords and string, and in their application to clockwork, to locks and other fastenings, to presses, to books, to paper-holders, to candle lamps, to window-sashes, to doors, to window-blinds, to seats and surfaces for lying and reclining upon. May 19; six months.

Alfred Markwick, of Langham-place, for improvements in the manufacture of epithems, used for medical and surgical purposes. (Being a communication.) May 20; six months.

Zachariah Major Parkes, of Peckham, surveyor, for improvements in the manufacture of coffins for the dead. May 22; six months.

Charles Thomas Lutwyche, of Birmingham, gold and silver chain-maker, for improvements in the manufacture of porcelain buttons. May 22; six months.

Hugh Greaves, of Hulme, Manchester, engineer, for improvements in the construction of railways and the carriages to be used thereon. May 22; six months.

Charles Wright, of Southampton-row, Russell-square, boot-maker, for certain improvements in the manufacture of boots and shoes. May 22; two months.

John Walker Wilkins, of Stanhope-street, Hampstead-road, for certain improvements in water-closets. May 26; six months.

Charles Bertram. of Gateshead, Durham, Esq., for certain improvements in the manufacture of artificial fuel, and in the application of the residual products to useful purposes. May 26; six months.

Timothy Kenrick, of West Bromwich, ironfounder, for improvement in glazing and enamelling the surfaces of cast iron. May 26; six months.

James Montgomery, of Salisbury-street, for certain improvements in the construction of steam-boilers and steam engines, and in steam-vessels, and in the machinery for propelling the same. May 26; six months.

Edward Alfred Cowper, of Smethwick, near Birmingham, engineer, for improvements in the manufacture of railway chairs. May 26; six months.

William Mayo, of Silver-street, London, manufacturer of mineral waters, for improvements in the manufacture of aerated liquids, and in bottling aerated and other liquids. May 26; six months.

## LIST OF PATENTS GRANTED FOR SCOTLAND FROM THE 22ND OF APRIL, TO THE 22ND OF MAY, 1846.

William Eccles, of Blackburn, Lancaster, power loom manufacturer; William Crook, of Livesey, hand-loon weaver, and William Lancaster, of Blackburn, Lancaster, power-loom weaver, for certain improvements in looms for weaving. Sealed; April 24.

John Barsham, of Long Melford, Suffolk, manufacturer of bitumin, for improvements in the manufacture of matresses, cushions, brushes, and brooms, and in machinery for preparing certain materials applicable to such purposes. April 27.

John Nott, of York. gent., for certain improvements in the means of communicating intelligence from one place to another. April 29.

William Price Struve, of Swansea, civil engineer, for improvements in ventilating mines. April 29.

Julian Van Oost, of Gendbrugge, near Ghent, but now of Osnaburgh-street, Regent's-park, Middlesex, gent., for improvements in treating seed, and in preparing materials used for fertilizing land, and for aiding vegetation. April 29.

George Hinton Boville, of Millwall, and Robert Griffiths, of Havre, in France, engineers, for improvements in apparatus applicable to the working of atmospheric and other railways, canals, and mines, and improvements in transmitting gas for the purpose of lighting railways and other places. April 29.

Peter Carmichael, manager for Baxter Brothers and Company, flax spinners and linen manufacturers in Dundee, for improvements in hackling or dressing flax, hemp, and other fibrous substances, and improvements in machinery for rubbing, stretching and equalizing the breadth of cloth made from flax, hemp, jute and other fibrous substances. May 6.

John Lloyd Bullock, of Conduit-street, Hanover-square, chemist, for improvements in the manufacture of quinine. (Being a communication from abroad.) May 6.

John Blyth, of St. Anne, Limehouse, Middlesex, for an improved mode of closing the orifices of bottles or other vessels applicable to inkholders. May 7.

Samuel Cunliffe Lister, of Manningham, near Bradford, York, gentleman, for improvements in carding and combing wool. May 11.

Alexander Parkes, of Birmingham, Warwick, artist, for improvements in the preparation of certain vegetable and animal substances, and in certain combinations of the same substances alone, or with other matters. May 11.

Pierre Armand Lecomte de Fontainemoreau, 15, New Broad-street, London, for an improved mode of constructing certain parts of the harness of horses and other beasts of burden. (Being a communication from abroad.) May 11.

Thomas Hancock, Stoke Newington, Middlesex, esquire, for improvements in the manufacturing and treating of articles made of caoutchouc, either alone or in combination with other substances, and in the means used or employed in their manufacture. May 12.

Frederick Harlow, of Paradise-street, Rotherhithe, Surrey, carpenter, for improvements in atmospheric railways. May 20.

Jean Joseph Ernest Barruel, of Rue St. Jacques, Paris, France, chemist, for improvements in working of certain sulphurets, to transform them into metals or oxides, and to collect the latter, also to collect the oxides from oxidized ores, equivalent to these sulphurets. May 20.

### NOTES AND NOTCIES.

*Scovill's Horse-power Drill* is a very ingeniously contrived machine for drilling into rocks, which may now be seen at the office of S. Atwater, Esq., No. 12, Merchants' Exchange. The drill, placed between a gallows frame, is raised by a crank motion, similar to the pitman of a sawmill, and carried with rapidity up the ways or slides to a point where it becomes detached from the nippers, and falls by its own specific gravity, changing its position the sixteenth part of an inch at every fall. When propelled by horse-power, it is estimated to do the work of twenty-five men, and leaves the rock in better shape for removal than the ordinary process of hand drilling. These machines have been extensively used upon the summit division of the Illinois and Michigan Canal, where they have been satisfactorily tested, and possess, in the opinion of the several engineers on that division, the merit of being cheap, durable, light, and very efficient, being computed capable of drilling in solid rock a 40ft. hole, five inches in diameter, in one day. We are inclined to look upon this drill as a great labour-saving machine, well worthy the attention of contractors, and destined to do away with the present tardy mode of hand drilling.—*Buffalo Patriot.*

*Mammoth Locomotives.*—The Great Western have just completed three most powerful locomotive engines, built upon the plan, and under the superintendence of Mr. Brunel, assisted by Mr. Gooch, the superintendent of the locomotive department. The dimensions of the Great Western engine (the leviathan of locomotives) are as follows:—Diameter of driving wheel, 8 feet; cylinder, 18 inches; stroke, 24 inches; boiler, between 15 and 16 feet; weight of engine, 36 tons, without water; weight of the tender, without either coke or water, 10 tons; making a total of 46 tons. This splendid engine, built for passenger trains, drew a train weighing 136 tons up the incline at Wootton Bassett, with as much ease and as fast as one of the smaller engines would a passenger train. The engine Queen is likewise for passenger trains, and was built at Swindon:—Driving wheels, 7 feet diameter; stroke, 18 inches; cylinder, 16 inches; boiler, 14 feet; weight of engine, without water, 25 tons; weight of tender, 9 tons, without coke or water. The above engines, when their machinery get into working order, are intended to be employed in propelling the express trains. The other is a luggage engine, the Premier, having her six wheels of 5 feet diameter connected. The dimensions of this locomotive are in other respects similar to the Great Western passenger engine. The Premier is decidedly the most powerful employed on the broad gauge, surpassing in strength and speed the Hercules engine, which propelled 406 tons on the experimental trip with the gauge commissioners.—*Railway Standard.*

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# Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1191.] SATURDAY, JUNE 6, 1846. [Price 3*d.*

Edited by J. C. Robertson, No. 166, Fleet-street.


## BIDDLE'S PATENT EOLIAN ENGINE.

Fig. 1.

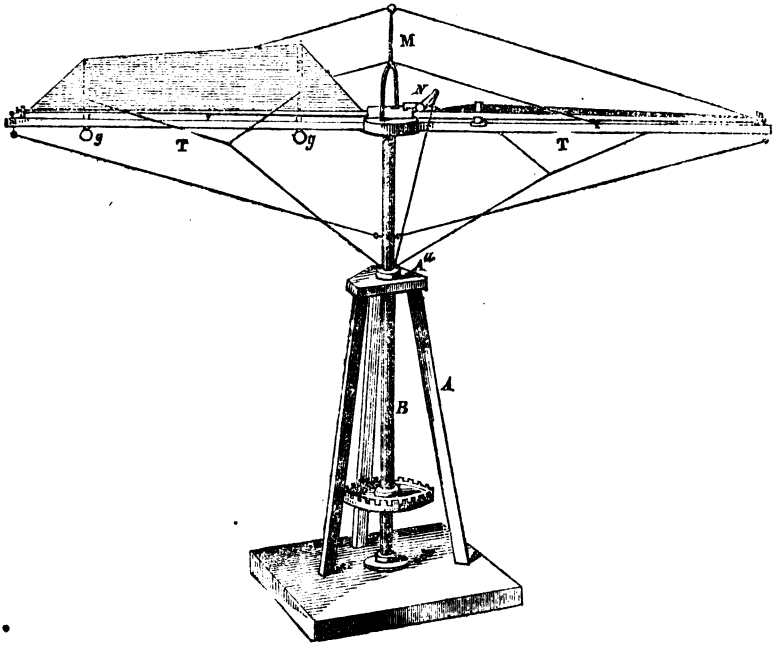
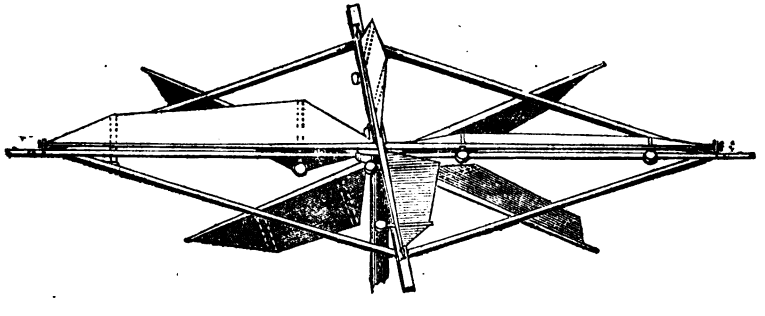



*Fig 2.*



## BIDDLE'S PATENT EOLIAN ENGINE.

[Patent dated October 20, 1845. Specification Enrolled May 2, 1846.]

THIS engine (of which we give an engraving on the preceding page) puts forward strong claims to public consideration, as it is calculated to bring within the reach of every one an impelling power which nature supplies bountifully in all situations. Whatever steam has done for us, there yet remains a field of vast extent, which it is found too costly, or too inconvenient to occupy; nor has anything hitherto appeared to supply that want of cheap motive power which is still felt in many agricultural operations, and all the minor departments of mechanical enterprise. The following brief description will render the engravings intelligible:—

Fig. 1 of the engravings represents an Eolian Engine in its simplest form. The ground framing (A) supports a vertical shaft (B) which turns in an orifice through the centre of the platform (A) and in a step at bottom. At the top of this shaft is a framework, consisting of two cross-bars, supported at their outer ends by stays from an iron upright (M) on the centre. On one of these bars, and running parallel with it, is a pair of sail-booms (T) united at the centre by a metal tube, and each carrying a sail. These sails are fixed on the booms to work at right angles to each other so that when either one is vertical the other must be horizontal, and they are counterpoised by weights (*g*) in order that they may take any change of position with ease, and the booms are hung so that they will turn freely on their axis. On exposing the engine in this state to the action of the wind, one of the sails will be immediately elevated to a vertical position, and the opposite one at the same moment depressed to a horizontal one; when, as in the case of a common vane, the machine will swing round, in doing which, the impulse given and the action of the counterpoise are found sufficient to cause the sails to change positions, when the evolution is repeated, and rotary motion thereby communicated to the shaft.

Though perfectly serviceable in this simple form, the same framework may carry any required number of sails, and constitute an engine of greater power but with some degree of complexity. For example, fig. 2, shows the same machine hung with eight sails, four on the upper side and four on the under, and each pair is at right angles to the other on the same side, and consequently neither sail takes the wind from the other, the power is by this arrangement quadrupled.

Though it would occupy some space to describe, we are able from personal inspection to vouch for the facility with which the sails are detached from each other, worked in that state, and all or any of them secured in a horizontal position, and again set in motion at the will of the attendant below, to whatever elevation the engine may be carried. By the employment of sails of different sizes, it is also evident that the machine may be adapted to work effectively in all weathers.

The principal advantages of this invention are these:—First, the extremely simple and inexpensive form in which considerable power may be gained by it, as an engine of a single pair of sails will be certain in its action, and of a power proportioned to the breeze and the surface of sail exposed to it. Secondly, The universality of its application, as every man may avail himself of, and turn to motive power, the wind which passes over his own premises. Thirdly, Its perfect safety even in the most complex form which can be given to it; as exclusive of the ease with which it may be controlled, regulated, or rendered powerless at any moment, it holds no wind when working but what is transmitted in power to the machinery, excepting only that which the bare spars meet on the returning side; and if needful, it may be supported quite independently of the building in which the machinery works. To these may be added, the absence of all liability to get out of order, the impossibility of its being taken aback or turned by the wind in a wrong direction, and the facility with which any part may be displaced and repaired without interfering with the efficacy of the remaining portion.

With regard to the extent to which the power of the engine may be carried, it appears to be a mere question of convenience, and fitness of materials. The same causes will produce the same effects on any scale of magnitude, nor does there seem any reason to doubt but that, if the main-yard of the largest man-of-war in the navy were slung across a shaft, a pair of sails on this principle of a proportionate size and strength would set it revolving with the same certainty, the same progressive increase of power, and the same facility of control as is found to rule in engines of smaller dimensions. Practically, however, it can scarcely be necessary, or desirable to go to such an extent.

Experience generally determines in all machines what is a *handy*, and what an *unhandy* size; and after a certain diameter it will probably be found cheaper and better to increase the power by an additional engine on the same shaft, or as it occupies literally no room below, to erect another shaft and engine altogether.

The irregularity of the wind as a motive power, may seem, in some cases, a formidable objection to this engine, but nine days in every ten, throughout the year, it may be expected to work effectively, and the periods at which steam-engines, or even water-wheels, lie idle, are not always at the discretion of their owners. At all events, there are a great variety of purposes to which it may be advantageously applied, where the occasional suspension of its labours for a few hours would be of no importance. As an auxiliary, moreover, to steam and water-engines on a larger scale, it may be most usefully adopted.

We entertain, on the whole, sanguine anticipations of the success of this engine, and little doubt that we shall soon see it in very general use.

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## OBSERVATIONS AND EXPERIMENTS ON THE CHEMICAL ACTION OF HEAT, PARTICULARLY IN REFERENCE TO DETERMINING WHETHER IT HAS NOT, AT HIGH TEMPERATURES, PER SE, AND INDEPENDENT OF THE AIR, A SLIGHT POWER OF OXYGENATION; WITH INCIDENTAL REMARKS ON THE ATOMIC THEORY, IN REFERENCE TO THIS ACTION.

BY HORATIO PRATER, M.D., PH.D.

(Continued from page 410.)

*Section Second.*

As a common balance only was used in the preceding experiments, (made for the most part at Nice,) in the following a balance, purchased of Newman, was employed, which unloaded, turned at the $\frac{1}{500}$th of a grain.

*Experiment* A A.—A bright sixpence weighing 40·48 grains, put a moment in contact with a red hot crucible under sand, was quite tarnished; yet there was no change in weight; not the $\frac{1}{500}$th grain increase.

*Exp.* B B.—A bright lamina of silver, considerably thinner than a sixpence, weighing 59·21 grains, put a moment at the same heat, was very slightly tarnished, acquiring a copper hue; yet it gained only the ·01 grain, the beam being thrown completely to one side, when $\frac{1}{500}$th grain more was put in the scale.

Kept ten minutes now at a red heat under sand, it acquired a black colour, and lost all metallic lustre, and was found to have gained $\frac{1}{4}$th of a grain more. Five minutes more at the same heat, but no further increase of weight.*

*Exp.* C C.—A similar experiment was made with bright copper turnings. Fifty grains of these being put for two minutes only in a red hot crucible, were made only slightly *blackish throughout*, as was shown by spreading them on white paper, and were found to have gained in weight the 34th of a grain. By exposure three-quarters of an hour more to the same heat, they gained 4·25 grains more, and were perfectly black.

*Exp.* D D.—A small covered platinum crucible was firmly pushed down into a Hessian crucible filled with Stourbridge clay, made into a thick paste with water, which was left two or three days to dry gradually. In the platinum crucible was a piece of bright steel wire, weighing fifty grains, and a piece of hard wood charcoal, weighing nine grains, and a few bright copper turnings. The crucible was perfectly filled with well-dried sand, and around the cover was put a moist mixture of two parts powdered glass and one powdered borax, the cover being bound on by wire. A smaller Hessian crucible was filled with a similar mixture of Stourbridge clay, and dried, and was now as a cover inverted over the one containing the platinum crucible, care being taken that every part between them was perfectly full of the clay. When dry, on the points where the crucibles joined, was put some of the mixture of glass and borax, and then a luting of Stourbridge clay and finely cut tow. Over this, when dry, was put another portion of the borax and glass made into a paste with oil, to prevent the cracking of the lute by farther heat. This crucible was now exposed for four hours to a bright red heat. Taken out, the luting was found to be free from cracks, and covered with a fused glass, and so firmly bound together that they were obliged to

* Berzelius says, that silver is not oxidized by heat. But when alloyed with copper (as in the above cases) it probably is so. But supposing that it was a sulphuret of silver that was formed, these experiments will show that sulphurets, as well as oxides, form gradually, contrary to Dalton's view.

be broken in pieces to get at the one of platinum. The cover of this was with difficulty removed from the crucible itself, on account of the fusion of the glass and borax, and when removed, the cover of the crucible was found here and there slightly corroded.

The steel wire was found now *completely* tarnished throughout. After gently rubbing off the portion of sand which adhered to it, this tarnished wire was found to weigh 50·22 grains, having gained nearly, or I may say completely, a quarter of a grain. Since owing to the adhesion of the sand, and the almost impossibility of freeing this from oxide of iron, this weight can only be looked upon as an approximation, and the *experiment* only establishes the fact of a *certain gain of weight* in conditions as nearly as possible excluding the access of air.

The charcoal retained the same form and had lost no powder, and consequently the following loss of weight may be considered as free from fallacy. It amounted exactly to 1·44 grain, or nearly 1½ grain.

As the charcoal could only lose in weight by oxidation,—by the formation of carbonic oxide, or carbonic acid,—this seems satisfactory evidence that the gain observed in the steel wire arose from like oxidation.*

The copper turnings were not blackened, but discoloured, looking here and there like brass and of iridescent colours, (the first step, as I conceive, of oxidation,) for copper filings boiled in water some time partially lose their lustre in this way.

*Exp.* E E.—A similar experiment was made at the same time as the above, with 50 grains large, and 60 grains of the *finest* iron wire, as fine as sewing thread, in a different (Wedgwood) crucible, covered and luted with Stourbridge clay, and glass and borax being applied (as in the above case) with the difference, that *heated* sand was also put between this crucible and the Hessian in which it was inclosed, in order to be sure the oxidation of the iron should not arise from the moisture of the Stourbridge clay permeating the Wedgewood crucible during the process of drying. The Wedgwood crucible was also filled with sand which had previously been purposely heated dry, and between the two crucibles was put a small piece of sheet copper, the same precautions being used to exclude air as in the former case. The lutings, after four hours' exposure to heat, stood equally well as in the former case, and were covered with a fused glass. Being broken up and examined, the sheet copper was found covered with thick scales of the black oxide; and the wires in the inner crucible were found tarnished throughout, the small wire being literally coated throughout with black oxide mixed with sand. Gentle motion was used to separate as much of the sand as possible, and a magnet employed to take up the black oxide. This was put with the iron wire, and found to weigh *conjointly* 65 grains; on boiling this in dilute muriatic acid, much sand remained undissolved, proving that the magnet is apt to take up foreign matters, enveloped, as it were, in iron filings. The exact quantity of sand was not ascertained, in consequence of an accident, but probably nearly half; so, as an approximation, we may consider the wire only to have gained from 1 grain to 1½ grain.*

The largest iron wire being uncoiled, (about a foot and a half in length,) was found, when carefully freed from all particles of sand, to have gained a little more than half a grain (viz., ·56 grain.) A small quantity of oxide of iron mixed with sand, was found to weigh ·35 grain. This, when heated in muriatic acid, lost, colouring the solution green, ·15 grain, which therefore consisted of oxide of iron to be added to the above ·56 grain, as constituting the whole amount of gain by oxidation.

Now, although from the union of the sand it was impossible to come to such very accurate results in these experiments as was anticipated, they all agree

* Exposed in a red-hot crucible for two hours 12 grains of charcoal left nothing but ash; and 12 grains of plumbago in the same time lost 5 grains; 12 grains of the former *under sand*, about 3 inches deep, lost in the same time about 5 grains, and 12 grains of plumbago not half a grain—if that. Hence charcoal, at a common red heat had a greater affinity for oxygen than plumbago has, in consequence, no doubt, chiefly of the cohesion and specific gravity of the latter being greater.

* Although the *wire itself* weighed only 57·3 grains, yet a considerable quantity of iron was taken up by the acid used on the powder (weighing, of course, to make up 65 grains, 7·7 grs.,) for the solution was quite green. As the wire had lost 2·7 grains, this must have been in solution; but certainly not more than a grain, or 1½ grain above this, *at most*. This oxidized wire on being again kept an hour red hot in an open crucible, gained barely ·3 of a grain.

in proving that there was always an increase of weight greater or less according to the surface exposed, and a corresponding change in appearance. The change in appearance was not therefore produced by any carbon or phosphorus which the iron might contain being volatilized; for in this case there might have been expected a loss of weight in the metal. The increase of weight was therefore probably produced by oxidation of the metal itself. That carbon lost weight under the same circumstances proves this supposition to be correct.

The change of appearance was not produced without change of composition, and it is very doubtful whether more accurate experiments would not show that this always accompanies a change of colour or appearance in all cases.

*Exp.* F F.—Iron wire weighing 50·02 grains was kept one minute in a red-hot crucible, and then directly put under cold sand, gained ·01 grain, and was blued, or very slightly tarnished.

Put in another minute, and under cold sand, gained, ·03 grain, and had lost all metallic lustre, having been heated red hot.

Put in again for six minutes, gained ·03 grain more. Put in again for twenty minutes, gained ·06 grain more. Hence, this iron wire, in twenty-eight minutes, had merely gained a little more than one-seventh of a grain. Put in again about three-quarters of an hour, gained quarter of a grain more.

The same large iron wire was used in this experiment, as in that mentioned as inclosed in the porcelain crucible. It was obvious, that this last accession of weight was caused in part by some portions of the oxide of iron having separated from the wire, and this left a fresh *surface* exposed to the air; for on the slightest touch, portions of the oxide were detached. Of course, therefore, this fact has been taken into account, when I have given it as my opinion, that the oxidation of the same surface of a metal takes place gradually. This was shown as satisfactorily by the last experiment as any of the others stated in this Essay, as we find the weight from oxidation was greater the second minute than the first, and in two minutes, of course no fresh surface could be exposed from any oxide falling off. The objection that the oxygen still might gradually penetrate will be tested presently by direct experiment.

In order to have a comparative estimate of weight in the best luted crucibles, and in the open air, fifty grains of the same larger iron wire as used in Exp. E E, which was also the same as that used in the last experiment, were exposed for four hours to a red heat in an open crucible, and also twenty grains of the finest, iron wire used in the luted crucibles.—(See *Exp.* E E.)

The former on being kept in an open crucible, red hot generally speaking, for four hours, gained only ·2 grain. Kept another hour in the same crucible fully red hot, did not gain above ·02 grain, if that.

The latter (20 grs.) gained ·52 grains in four hours. Suspecting that the slight increase in weight in this case arose from the iron itself not having been red hot, except occasionally, (for the crucible itself was not always red hot,) I put fifty grains of the same wire on red hot cinders for ten minutes only, during which time, the greater part of the wire was itself red hot, and on weighing it, I found it had gained double (viz. four grains,) what it had in the experiment just mentioned. I consequently determined to submit the same wire to the influence of red-hot sand, by which means, the wire would itself, by such contact, be kept completely red hot; for when, in the above experiment, the crucible was red hot, the wire itself was not so, except in those parts *in contact* with the crucible.

*Exp.* G G.—The fifty grains of iron wire just mentioned as having gained ·4 of a grain (50·4 grains oxidized wire) was put at the bottom of a large crucible; this was now completely covered by sand, the sand reaching about an inch above the wire. On this sand was now put 50 grains of the same *polished* wire, which was likewise covered, but only just covered, by sand. The crucible was kept completely red hot three hours, after which period the oxidized wire was found to have gained a little more than 5·8 grains. But as this contained a quantity of sand adhering firmly to it, the crust of oxide was removed as far as possible. This mass weighed 15·2 grains, and being digested in hot muriatic acid till the sand was left quite white, and then well dried, was found to weigh

three grains; which being deduced from 5·8 grains, leaves 2·8 grains for the weight gained by the oxidized wire.* The bright wire gained 3·6 grains only, and the quantity of oxide that could be rubbed off, weighed only 7·8 grains, which showed that oxidation had penetrated more deeply in the oxidized wire than in this; and the only reason to be assigned for this is, that the oxidized wire was probably exposed to a higher red heat, being at the bottom of a thin crucible, than this polished wire, to which, however, the access of air must have been more free—a circumstance that will convince us how much exposure to a high heat facilitates the oxidation of iron.

Treated in the same way as the oxidized iron, these 7·8 grains were found to contain 2·3 grains of sand, which taken from 3·6 grains leaves 1·3 only for gain by oxidation; which was as nearly as possible the amount gained by oxidation of another portion of the same wire kept two hours on red-hot cinders.

On comparing the result of these experiments with that in Exps. D D, and E E, and F F, it is sufficiently clear, that iron wire in contact with red-hot sand is much more deeply oxidized than that merely left in a red-hot crucible; and also that such wire is oxidized to a greater extent than if it were kept in red-hot sand in well-luted crucibles. For, while fifty grains of the same iron wire gained in well-luted crucibles scarcely three-quarters of a grain, we find it to gain, placed in the same circumstances under sand, in an unluted crucible, either 2·8 grains, or 1·3 grains, variations depending probably on the difference in the heat in the two cases. But here it must at the same time be confessed, that it is not probable that the amount of heat in the experiments with the well-luted crucibles was as great as that in the open, because the latter was a particularly thin Hessian crucible, and also because the iron wire (in Exp. E E) was put in a Wedgewood crucible *within* a very thick Hessian crucible.

Again, in favour of the idea that the difference in amount of oxidation in well luted and open crucibles is not so great as these results might induce us to believe, the experiments with the finest iron wire in the same luted crucibles may be referred to. As an approximation, I have concluded, that sixty grains of this did not gain more than one and a half grain; but we find (Exp. FF) twenty grains of this, in an open crucible, gained in four hours a little above half a grain.

Hence for 60 grains the amount of gain would have been from 1 to 1¼ as nearly as possible; the amount of gain I have conjectured took place in the well-luted crucibles. In this estimate, indeed, the heat in the two cases is considered the same, and I am inclined to think there was not any considerable difference in this respect, since the fine wire was rolled up into a tolerably solid ball, and in consequence, much more of it would be constantly in contact with the sides of the red hot crucible than in the case of the thick iron wire.

Hence, although this fine iron wire was not under red hot sand, as it was in the luted crucibles, still when we consider the thickness of those already mentioned, and the fact just stated that so much more of this wire would be in contact with the sides of the crucible than of the thicker, I think we may consider that this comparison tends to the same point as the one previously instituted, viz., that iron oxidizes in close vessels, from whatever cause, to pretty nearly the same extent that it does at the same heat in open vessels; or to take the safer and more probable side of the question (as there is great difficulty in these cases in ascertaining the exact amount of heat) that iron oxidizes very visibly in vessels made as air tight as possible.*

Another conclusion that may be drawn from these experiments is, that oxidation takes place gradually in consequence of oxygen penetrating the metal. Now, although this is the same, or nearly the same as acting (increasing weight) by attacking a fresh surface, still the following consideration will convince us that the process even in these circumstances must take place *gradually*, and not as

* The very strong affinity of iron for oxygen at a red or white heat may be gathered from experiments of this character; for the gas must be solidified, notwithstanding that the temperature so forcibly opposes such solidification.

* The experiments with charcoal and plumbago already mentioned are rather in favour of this latter conclusion, since we see that these diminished more in weight in an open crucible than under sand.

seems generally supposed, *at once* in the atomic proportions of the different oxides of iron.

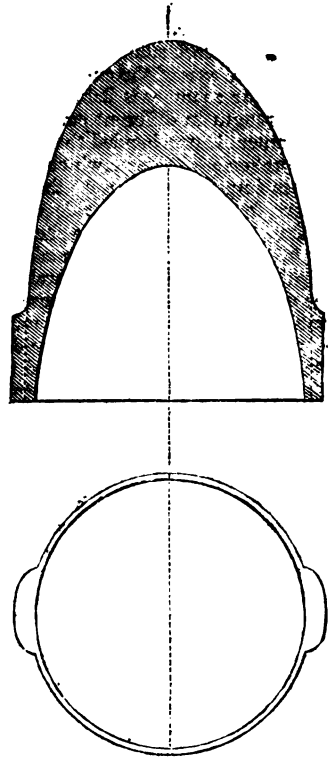
Mosander, says Berzelius, (Traité, tom. iii., Oxides de Fer,) in analysing the external coat of oxide of iron, which forms, when a plate of iron is exposed to long-continued and great heat, found it composed of 64·23 of ferrous oxide, and 35·77 of ferric oxide. But on separating this into two layers, exterior and interior, he found that the generality of ferric oxide diminished from without to within, and consequently, that this external coat was not composed of a homogeneous mass. Again, to the same effect, Berzelius himself, in a passage before the above quotation, says the external surface of iron, so exposed, has a slight tinge of red which does not extend externally; clearly showing, along with Mosander's experiments, that the quantity of oxygen is greater the nearer we approach the surface. Now, as such is the state of the case, it is pretty clear that weight is not increased, merely because oxygen penetrates, and thus combines with a fresh surface, but that it also combines with a surface already oxidized; in other words, because oxidation takes place gradually.

To be sure, the supporters of the opposite opinion, may say, that still the ferric oxide is not formed imperceptibly by a *gradual* addition of oxygen to the ferrous oxide, but *at once;* yet, I think the experiments already detailed on the oxidation of surfaces of silver and copper, and even iron (Exp. F F,) in which the weight gradually increased, tend to support the opinion, that oxidation in metals takes place gradually, and that many different intermediate oxides, between those commonly recognized, exist. Thus, for instance (Exp. C C,) where copper is only slightly blackish, and absolutely black, and it is probably combined with oxygen in different proportions.

(*To be continued.*)

## GUNNERY—MR. HOLDSTOCK'S NEW RIFLE BALL.

Dear Sir,—Long ago I promised you another paper on Gunnery, and now I will endeavour to lay before your readers a short account of what I have been doing, and what others have done with regard to certain projectiles.



Soon after the paper was written, which you did me the honour to insert in the Magazine, the artillery officers of France were much interested in a new form of shot described in the English newspapers as "sphero-cylindrical," or "spheroconical," and sometimes by the name of Delvigne's shot. One of my friends, who was on the Continent at that time, soon after described it to me as shaped like a sugar-loaf with the base depressed into a chamber, like that in my shot. The edge of the base was thin and expanded on the explosion of the charge, thus fitting the barrel exactly, and allowing no force to escape by windage. The French officers found that this shot flew with great accuracy to a mark at a long range.

I immediately applied these principles to a shot for my two-grooved rifle, and from the *Chronicle* newspaper of last Friday, I learn that another person has done the same, with the success that might have been expected from the re-

sults of the French experiments. The sugar-loaf form may be described more properly as parabolic, and as the tangents to a parabola on each side are not parallel to the principal axis of the curve, and as the edge of the chamber is liable to be of unequal strength in different parts of its circumference, I apprehended that a motion of libration might ensue, which would sometimes impel the edge of the shot with more force against one side of the barrel than another. To lessen the possibility of this evil, I afterwards adopted the elliptic curve, instead of the parabolic, for the exterior of the shot, because the tangents at the extremity of the axis minor of the ellipse are parallel and coincident with the sides of the barrel. I send two models of this kind for your inspection, that were made some time ago by Messrs. Jones, of Holborn, and though the workman has made the chambers a little deeper than I intended, yet after firing a great number of these shots I have much reason to be satisfied with the accuracy of their flight. Since a projectile of this kind can be made light or heavy, without changing the nature of the curves, it is in this respect superior to the common belted ball of the service. When a shot is heavy, it ranges farther, but the explosion of the powder causes more recoil, as appears from the equation.

$$Wv = wV$$

Where W is the weight of the gun, $w$ the weight of the shot, V the velocity of the shot, and $v$ the velocity of recoil in the gun. If $w$ and $v$ in this equation are variables, the other letters being constant, when $w$ is increased, $v$ increases in the same ratio, which shows, that doubling the weight of the shot doubles the velocity of recoil. The English rifles are usually made too light for their calibre, and have in consequence, too much recoil. For this reason, the weight of the shot I employed did not differ materially from the weight of the belted ball for the same calibre.

I remain, dear Sir,
Your faithful servant,
C. A. HOLDSTOCK.

May 26, 1846.

*Note.*

Arming as we are "up to the teeth" one would imagine that every suggestion, from whatever quarter, which affords the slightest promise of increasing the effectiveness of our warlike missiles, would receive all possible encouragement from our military authorities. We believe, however, that this is very far from being the case, and that there is but too much foundation for the complaint made in the extract which we gave a few weeks ago (p. 191, current volume) from the "Westminster Review," that it is considered by those authorities "sheer impertinence" for any *civilian* to think he knows anything about such matters as rifles, percussion caps, gunpowder, &c. We have since then met with "Wade's London Review" for March and April, 1845, and read there what is humorously styled "A Farce in two acts," which turns upon the "ow'r true tale" of the scurvy reception experienced by the inventor of a new rifle ball, at the hands of the well-known "select committee" of Woolwich officers. The rifle ball there alluded to is identified by an expression of one of the *dramatis personæ*, as being that invented by the author of the preceding communication, and described by him in our pages, as far back as July 15, 1843. Without offering ourselves any opinion as to the worth of the invention (though we may observe, by the way, that we have heard it spoken of by a highly competent authority as founded on the truest mathematical principles) we can have no hesitation in pronouncing the sort of trial to which it was subjected at Woolwich, to have been alike unfair to the inventor and discreditable to the committee. We have prefixed to Mr. Holdstock's present communication a plan and section of one of the two specimens sent to us of his shot, on a scale three times the actual size, in order that our readers may be the better able to judge for themselves of its merits.—ED. M. M.

MISCELLANEA MATHEMATICA.—NO. XIII.

*Engineering and Architectural Geometry.*

The consecutive development of geometrical truths, depends mainly upon the mode in which we start from our first principles. The simplicity of the leading principles is the main object to be

kept in view; and these have been proved, by the total failure of numberless attempts at alteration, to be given in the best possible form (always abating some trivial matters of detail) by Euclid himself. Even Legendre, the most logical, and Leslie, the most imaginative of all the authors who have attempted to supersede the Alexandrian, have still been compelled to keep too close to the antique model, to justify the anticipation that theoretical geometry will ever put on a face which has not a striking likeness to her present one. Few suggestions of any consequence can be made to the student, as to his acquisition of the theory of geometry, beyond what have already been offered.

We have before expressed our estimate of the delicacy, refinement, and subtlety of Euclid's treatment of the doctrines of ratio and proportionality. There is not to be found in the whole range of modern analysis anything more remarkable and more recondite in its conception than the fifth book of the "Elements." Yet were we to advise a material departure from Euclid's plane geometry in anything, in our address to our present readers, it would be with respect to this book. It is too abstract to be intelligible to the generality of minds under every circumstance of education and social idea; and hence its force is seldom felt and its beauty rarely appreciated by those who read it. Besides, the same truths may be deduced in a much briefer manner; and that manner much more nearly assimilated to the ordinary conceptions which we have been led, in early life, to form of ratio. Certainly the most familiar idea we have of ratio is that of the *number of times* that one magnitude is contained in another of the same species; and this brings us at once to view the doctrine as one of *number*, and at the same time places it in the domain of pure algebra. It is thus that Legendre views it, and in his *Géométrie* he does not even consider it necessary to lay down the fundamental doctrines of proportion. For an *academic education*, in which the main value of any geometry is the training of the mind to habits of close and difficult reasoning, we should most rigidly adhere to Euclid's method; though we should deem it necessary to offer much explanation and illustration of a kind not usually afforded to academic students: yet in reference to the studies of practical men, we do most decidedly advise the adoption of the more compendious, and more easily intelligible processes that algebra furnishes for establishing the same truths. Nor do we thus advise upon a hasty opinion; for we have thought much upon this matter.

The principal objections brought against this proceeding are:—

(1.) The *impurity* which is introduced into geometrical science; and

(2.) The difficulty of dealing with incommensurable quantities.

As to the first objection, we have already expressed our conviction of the arbitrary character of the canons which decide upon the purity or impurity of a process. We are not, as reasonable men, bound by such canons; and are as much at liberty to form our own, as Euclid was to form his. We are only bound to reason validly; and that which constitutes an irrefragable proof, we are at full liberty to be satisfied with. As professedly orthodox geometers it is quite another matter: and if we range ourselves under the banners of the school, we are bound by all its dogmas, and trammelled with all its rules. It is, however, the validity, and not the form, of the demonstration that concerns us.

It does, indeed, almost appear that Euclid himself viewed the doctrine of ratio to be a less purely geometrical one than that which governed the composition of the first four books. On what other principle can we account for the laborious construction of *ii.* 11, and the complicated demonstration of *iii.* 35, 36, which admit of extremely brief and elegant treatment by means of proportionals? The neat inscription, too, of a pentagon, by the method of Ptolemy, had been excluded from general knowledge till Bonnycastle, some seventy years ago, demonstrated that construction independently of proportionality.

With respect to the second objection, it is now, whatever it may have been formerly, an argument out of date. There is really no truth in the statement that the doctrine of ratio in respect to incommensurable quantities is either difficult or complex. However, before the student, who shall follow our suggested course *ab initio*, shall have arrived at this subject, and have studied the alge-

braic theory of ratio in respect of commensurable quantities, we shall have laid before him, (in one of this series of papers,) a sufficiently ample and complete discussion of the particular difficulty to which we refer. We might have done it at this moment, but that we are desirous of first giving him a general view of the character of the subjects, and especially their application, to which we would direct his attention.

It has been already said that Euclid's constructions had not the least reference to practical convenience of operation, nor to the contingencies of circumstances under which a problem may require solution. He never considered that one part of his operation might fall without his drawing board, nor that several lines which may be rendered effective in the construction might have already existed in the diagram. All his processes, as far as his purpose rendered them necessary, "begin with the beginning:" his lines and his planes are extended, or extensible by postulate, *ad libitum;* his data may have relative positions that render the *physical* solution absolutely impracticable. His only discrimination of cases is that in which the *description* of the process becomes varied by means of special relations amongst the data; and for the most part he makes each of such cases into a separate proposition, and gives the requisite general construction of each—as, for instance, in propositions 9 and 11 of book *i.*

Most writers, who have professed to treat of practical geometry, have felt the necessity of departing from these restricted rules of construction; and of the easier and more familiar class of problems, they have given these *exigential cases*, and their constructions. In this they have done wisely; but the extent to which, for the most part, they have carried out this plan is extremely limited. Perhaps, in the construction of perpendiculars, parallels, and circles, little is left to be done; but it ought to be remembered that these processes, though of constant occurrence, are not the only ones that present themselves in practice. Nor is mere plan drawing composed entirely of such processes in plane geometry as are to be found in any theoretical work on the subject. Neither, again, is the whole of the engineer's drawing to be performed upon paper. An important portion of it is to be done in the field, upon a scale so large that the character of the instruments must be changed, and consequently the processes themselves must undergo a total constructive change: and, moreover, no small number of operations are necessary, and many more would be desirable, to be performed upon other than plane surfaces, as upon cones, spheres, cylinders, and surfaces of revolution, generally. For these operations no systematic instructions are to be found in English works, beyond an occasional, and oftentimes erroneous and empirical device that has been, for ages, handed down as a professional heir-loom amongst the "secrets of art." To supply these demands, the highest order of geometrical skill is required:—but of this hereafter.

In speaking of Euclid's problems we have in a modified degree given the character under this aspect of all the ancient writings on geometry, though still in a sense that requires considerable modification. Many of the efforts of the Alexandrian school were directed towards the solution of certain problems,—two principally,—the trisection of an angle, and the duplication of the cube. Failing to effect these according to the canons of that school, by means of the straight line and circle; yet in their researches they were led to the discovery of properties of geometrical figures of the highest speculative interest, and to the solution of problems of the utmost value even in our own day. We may instance the treatises of Apollonius especially, on the problem of tactions, the section of ratio, and the section of space.*

* A very neat and succinct account of the ancient books, written with the purpose of facilitating the geometrical analysis, is given in the Notes to Leslie's work on that subject, which we subjoin. A tolerably full account of the mathematical collections of Pappus, may be consulted under that word in Hutton's Mathematical Dictionary.

1. The *Data*—*περὶ τῶν δεδομένων*—in a single book of considerable length, but containing propositions only of the very simplest kind.

2. The *Section of Ratio*—*περὶ λόγου ἀποτομῆς*—in two books, which Dr. Halley, with much sagacity and incredible labour, restored, from a manuscript in the Bodleian library. The object of the tract was a solution of this problem, branched out into a multitude of cases, and marked with various limitations: "Through a given point to draw a straight line intercepting segments on two straight lines which are given in position, from given points and in a given ratio."

It was found in their analyses that so many, respecting almost every kind of subject, ultimately resolved themselves into one or other of these problems, that the geometer of Perga was led to examine all the separate cases to which the relative positions of the data gave rise. These problems were thus placed in the same category with the simpler ones that occur in Euclid's Elements, as so many stations at which the labours of the geometer may terminate, without retracing his steps back to the earliest problems of the geometrical series. Several of these problems have, however, subsequently received much more concise and elegant solutions. The problem of tactions especially has been treated with great simplicity and beauty by several foreign writers, by employing the method of centres of similitude and radical axes,—and the remarkable discussion of it by Steiner, in the seventeenth volume of Gergonne's *Annales*, leaves nothing more to be done on this subject. That most able geometer, the late Mr. Swale, of Liverpool, too, in his "Geometrical Amusements," has reduced the whole of the problems of Apollonius to one more general, and of singular beauty. Sir John Leslie, in the work quoted in the preceding note, has also discussed the principal cases of the Apollonian problems with his characteristic originality; but in one or two of them he has committed oversights somewhat grave. Elegant solutions on the Leslian principle, in which those defects are entirely removed, have been furnished by an able geometer of our own day, Mr. Godward, of the Nautical Almanack Office, Gray's Inn.

The researches of the ancients concerning the conic sections were carried to a great extent. Still the spirit of those researches was precisely similar to that of Euclid's Elements. No more of the practical was brought into play than was absolutely necessary in aid of demonstration; and hence the same remark applies to the great work of Apollonius on this subject, that applies to the "Elements" in simple reference to *practical* rules of construction. Neither is his classification of properties a convenient one, even for *theoretical* purposes; and it has therefore been altogether superseded by more modern works even under this aspect. Few men, indeed, now living, have ever looked into Apollonius; those only, indeed, who have been led by their tastes to devote a more than usual attention to these curves under a strictly geometrical form. It cannot be denied, however, that in mo-

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3. The *Section of Space*—περὶ χωρίου ἀποτομῆς—in two books. Of these no vestige remained, but Dr. Halley, guided by a few hints from Pappus, very successfully exerted his ingenuity in divining the original structure. It was proposed—"Through a given point, to draw a straight line cutting off segments from given points on two straight lines given in position, and which shall contain a rectangle equal to a given space."

4. The *Determinate Section*—περὶ διωρισμένης τομῆς—in two books. These were also lost; but Dr. Simson, assisted by the attempts of Schooten, has restored them in the most luminous manner. Their object was—"To find a point, the rectangles or squares of whose distances from given points in the same straight line, should have a determined ratio."

5. *Inclinations*—περὶ νένσεων—in two books. It was proposed—"To insert a straight line, of a given magnitude, and tending to a given point, between two lines which are given in position." This problem was restored by Marinus Ghetaldus, a patrician of Ragusa; and other investigations were given by Hugo d'Omerique, in his ingenious treatise on Geometrical Analysis, printed at Cadiz in 1698. Two solutions of the case of the rhombus, remarkable for their elegance, appeared in the posthumous works of Huygens, who was imbued with the finest taste for the ancient geometry.

6. *Tangencies* — περὶ ἐπαφῶν — in two books. Of this tract only some lemmas were preserved, which enabled the celebrated Vieta in a great measure to restore it. Some of the cases which had escaped him were solved by Marinus Ghetaldus; and farther improvements were made in 1612, by Alexander Anderson of Aberdeen; an ancestor of the Gregorys.

7. *Plane Loci*—περὶ τόπων ἐπιπέδων—in two books. The object was—"To find the conditions under which a point, varying its position, is yet confined to trace a straight line or a circle given in position." This beautiful train of investigation was partly restored by Schooten in 1650, though after a sort of algebraical form. The ingenious Fermat succeeded in bestowing greater simplicity on the subject. But all these attempts have been eclipsed by Dr. Simson, whose treatise *De Locis Planis*, published at Glasgow in 1749, is a model of geometrical strictness and elegance.

The six preceding branches of analysis were all the creation of Apollonius of Perga, the most assiduous and inventive of the Greek geometers.

8. *Porisms*—περὶ τῶν πορισμάτων—in three books, composed by Euclid. No trace of these now remains, except some obscure hints of Pappus, rendered still more perplexed by the corrupt and mutilated state of his text. The subject had long proved an enigma which it baffled the efforts of the ablest and most learned mathematicians to unravel. Fermat advanced some steps; but the honour of completing the discovery was reserved for our countryman, Dr. Simson, whose restoration of the Porisms was given to the scientific world in 1776, in a posthumous volume, printed at the expense of the late Earl Stanhope. From that work I have extracted what seemed best suited to my purpose; and I have likewise availed myself of the judicious remarks and illustrations of my late distinguished and most lamented colleague, Professor Playfair.

dern practical as well as modern theoretical science, the conic sections are the most important of all the subjects of geometrical study. We need not point out how frequently they present themselves for study and construction in the most familiar operations of our profession. But we feel called upon to express our entire condemnation, (whether in respect of a liberal or of a practical education,) of the system of study which substitutes an analytical treatment of these curves for a strictly geometrical one. We shall, however, have occasion to revert to this subject in our paper on the recent "Cambridge Graces." We also feel bound to enter our caveat against any system of developing the properties of these curves, which does not start with some fundamental property of the intersection of the plane and cone. Boscovich appears to have been the first to depart from the usual method in this respect. He has been followed by (Thomas) Newton and Hustler in Cambridge, and by Sir John Leslie of Edinburgh, amongst geometrical writers on the subject; whilst the great majority of those who have composed treatises on the "analytical system" have adopted the method of Boscovich. All distinct geometrical ideas of the curves are, however, rendered difficult to attain, and in most cases impossible, by this method; whilst, *in the end*, very little, if anything, in point of time is gained, to compensate for this vagueness of apprehension. Why, then, adopt it? Little other of reason, we think, can be given, than the vanity of being as "unlike as possible to the common works on the subject."

Our present notice of the conic sections being intended to have a practical bearing, we, therefore, as a general rule, advise the study of only the *general properties* of these curves, together with those peculiar ones that have an immediate influence upon the construction of the curves themselves, and the solution of *problems* relating to them. For this purpose, the method of *transversals*, (the first attempt to systematise which was made by Carnot, (though the first application of the principle to constructive purposes was doubtless made by the great architect and geometer, Desargues, of Lyons,) appears to be by far the best adapted. Many foreign writers have developed the properties and constructions of the conic sections under this aspect; but we do not recollect to have seen any English work in which the method has been employed, except the last edition of Hutton's Course, in which it is treated with some degree of amplification, though still not so completely as we could desire. The student, however, who shall have studied the chapters devoted to this subject with due care, will find himself in a condition to carry on any subsequent research that may offer itself without difficulty. In fact, we conceive that the true business of elementary books is not so much that they should contain every property of a figure, as that they should put us in possession of the principles, and engender a habit of self-dependence, that shall enable us to follow out the minute details and applications for ourselves.

Of the organic description of the conic sections we have little to say, beyond, that an instrument for the purpose, generally, is yet a desideratum. We do not wish to be understood to speak slightingly of many inventions for this purpose. As far as the ellipse is concerned, considerable mechanical ingenuity is displayed; but as as our own wants have led us to examine with care the operation of all the instruments that have come to our knowledge, we have had that kind of experience which still forces us to say that a really serviceable elliptograph is itself still a desideratum. We still, as a general rule, prefer, both for facility and accuracy, the method of constructing by points, and trusting to our manual readiness for tracing the curve. Others may judge differently: but such is our own feeling on this head. It is, strictly speaking, a personal question—one of experience and convenience,—and one in which every draughtsman is entitled to decide for himself. If, however, we concede the perfection of the elliptographs in present use, we must not fail to remind the reader that no one of them is applicable *till we have found two conjugate diameters*, nor generally, *till we have found the principal diameters*. Suppose, then, the five conditions which determine an ellipse to be any whatever, (cases the most frequent in extended practice,) is it not obvious that a considerable amount of preliminary and often intricate construction becomes essential for the determination of these diameters? All this

must be done before any elliptograph can be brought to bear on the solution; and this will often cost far more labour, and involve a greater number of marks and lines on the paper than the construction of twenty points in the curve would require. Besides this, whatever errors might be committed in these operations for finding the diameters they would all be accumulated in the terminal result, and tend to modify the general curve; whilst, in constructing by points, the result of each error would affect, by its own amount only, the one point thus independently determined. A better estimate can thus be made of each separate error (and if necessary, due allowance for it) than when all these errors are combined in one final result, such as would be inevitable when we employ the instruments in question.

After all, let it be remembered that the parabola and hyperbola are yet unconstructed by organic processes which any one can for a moment suppose to be usable, much less convenient. Yet these curves are surely required in architecture and engineering!

We feel, therefore, fully justified in advising the method of constructing by points. Many systems for this purpose have been proposed; but probably the use of the "mystic hexagram" of Pascal is one of the simplest forms under which the method can be propounded. Newton's revolving angles, too, have met with favour amongst several French geometers; and the method has been ably and amply discussed by Leslie. The methods of Maclaurin and Braikenridge were simply an application of Pascal's principle; but it has been reserved for the modern French writers, especially Brianchon, to fully develop the method. His *Application de la Théorie des Transversales* (1818,) and his *Mémoire sur les lignes du second ordre*, (1817,) will repay the study of every practical man.

With plane geometry and the conic sections, the geometrical splendor of the Greeks terminated. Their conceptions of the geometry of space was somewhat confused, and their researches in this department of science were extremely limited. Upon this subject we must postpone our remarks till a future number of the *Miscellanea*.

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SCREW PROPELLING—OBSERVATIONS ON THE LETTERS OF COMMANDER HOSEASON —BY CAPT. HALSTED, R.N.

Sir,—On my return lately from the sister isle, I find that the pages of your valuable periodical have been for some time past rather largely occupied by a series of letters from Commander Hoseason, intended to guard his brother officers from the danger of having "foisted on them" the "erroneous opinions" of the advocates of screw propelling. After applying himself with apparently more diligence than wisdom to make a collection of "facts" *fit for his purpose*, he founds on them such a chaos of (as yet) unanswered argument, proving so *simply* the "manifold mischiefs" and black catalogue of evils inherent in this method of propulsion, that we are at a loss as to which of the gallant commander's qualifications for the office of naval Mentor most claim our admiration—the high order of his reasoning powers, or the generous devotion of his heart. From their Lordships at Charing-cross to the youngest tyro just launched, there can surely exist no doubt throughout the entire service of our obligations to him. And for my own part, I trust you will not refuse me the pleasure of using your pages not only to express my sense of gratitude to the worthy Commander, but further to offer for his free use, in all sincerity and friendship, the small collection of "facts" connected with this subject which I, too, in "hours of idleness," on half-pay, have scraped together.

Before detailing my own experience, however, I stop to take one or two admiring glances at the novel points of view in which the gallant commander's "facts" have led him to place the general subject. And the first of these which arrests attention, is the necessity, never even dreamt of by these dreamers of the screw, that *before* their favourite principle of propelling could be admitted even to a rivalship with the paddle, it ought to have exhibited its claim, in a decided superiority, or at least equality, on all important points with its antagonist; in fact, that it ought at once,—hop, skip, jump,—to have appeared on the stage, to solicit the favours of the public in a state very near perfection! Never mind that the course of all human experience, from the earliest days to the present, proclaim that

in such matters our advance towards that desirable end must be by toil and patience. Never mind that the history of the paddle itself forms no exception to this law of necessity; nor that for the last twenty years the brains of the wisest, and the knowledge of the most experienced have been expended in bringing it to its present position (and well it has undoubtedly replied to the trouble taken with it.) All this is now to be set aside, the established laws of progress are now to be superseded. The paddle has now arrived at the stand-still of improvement; and, therefore, the various attempts made to ascertain the best proportions to be given to the screw by the trial of fourteen screws in the *Rattler*, and twenty-two screws in the *Dwarf*, are to be looked on as but affording indubitable proof that its friends are as crooked-minded as the instrument itself, and have yet to be instructed in the very first principles of fair play.

Again, let me pause to admire the clear-sighted view exposed by the gallant commander when he contemplates the objects which these "frantic schemers" propose to effect by the adoption of their mode of propulsion into our profession. What are they?

First. It greatly reduces, they say, the dead weights of hull, engines, and expense; while those weights which must remain, will yet be so disposed as to give increased stability, ease, and therefore durability to the fabric.

Secondly, The batteries of both main and upper decks are cleared of obstruction, and the armament permitted at once to be increased and more efficiently worked. This as regards *bonâ fide* steamers, while, as regards our fleet of frigates and liners, each may, if so desired, be *accommodated* with any amount of steam power, without interference with either the number or range of their guns.

Thirdly, It enables the steam power of both steamer and auxiliary to be made when compared with that of the paddle steamer, invulnerable.

Fourthly, It facilitates the management and steerage power of all ships of all sizes and in all cases in which it is applied.

Fifthly, It enables the power of wind and steam to be at all times (except one) used; neither interfering with the other, but both being able to act conjointly according to their respective powers, and thus it promises to give us the highest speed yet attained on the ocean.

Sixthly, *It will effect a large economy of fuel in all steamers in which it is used.*

Lastly, but not least, it will preserve to us the great national advantages we possess from our extended commerce and insular position, in the superior practical seamanship of our maritime population. Who has not felt the some-sort of truth contained in pamphlets blown into this country from the other coasts of the Channel? The admission freely made that the number and practical ability of our seamen renders all contention with us by sailing fleets on the ocean hopeless; but the gloating satisfaction with which it is added that steam, ay, paddle-steam, had removed this superiority, and afforded but little scope for the qualities of the seaman. The reply is now this: That as the power of the sails may at all times (but one) be used, not to the injury, but, if need be, to the aid of her steam, so must everything connected with this means of progress be now as anxiously the object of the seaman's care as when he was provided with it alone; and thus while the screw steamer goes forth to execute her country's will in every quarter of the globe, in the united strength of both powers, she becomes in proportion to her size a school of naval discipline and practical seamanship as valuable as the frigate.

Such, Mr. Editor, are the "mischiefs" concocting by these screw projectors for the annihilation of the British steam navy, and which, if permitted to proceed, we now know, thanks to Commander Hoseason, will only render it "useless" on the ocean. What an insidious thing is this screw! What a traitorous crew her advocates! Mr. Editor, with shame I confess it, I have been one of them. I have been long in their counsels and their confidence. I know the grounds of their hopes and expectations. I have witnessed the anxiety of their labours, mental and physical, to effect their aim, and,—shall I go on? yes, I will make a clear conscience at once—in my simplicity I did believe their statements, their confident assertions, and I aided them in their work. But, it is now clear that I was cajoled, duped, victimized. I did

think these objects, if secured, would strengthen my profession and my country; I watched with increasing confidence the events which were almost daily arising to advance their attainment, but ungifted with the mental penetration of our guardian, I perceived not the lurking poison; I never pondered over the *great slip* of the *Bee*, I never witnessed the contempt for *expansive* action exhibited by the screw of the *Rattler*. But now my eyes are opened, and the eyes too, no doubt, of other victims. Now we know, that if some of the objects above enumerated are improvements at all, they are but as the dust in the balance compared with the immense disadvantages exposed by the great "facts" which the Commander has made public.

But good people of England, fear not; you are now secure. The steam navy which protects you shall not be rendered "useless" by these machinations. Its great champion has taken his firm stand upon the paddle-box. And when we view the extent of the services already rendered; remember "that his first" onslaught "told with fearful effect"—that "his second settled the question for ever;" so that, Alexander like, he weeps that "a foe worthy of his steel is not to be found," how can we fail to raise our eyes in grateful admiration, and adapting to himself the great words which he modestly could only apply to his cause, salute him with, "*Magnus est* HOSEASON *et prevalebit*."

But from the contemplation of these *just* and *peculiarly expansive* views of the subject, let us now descend to examine a few of the facts; and as in duty bound, I will first notice those which are connected with the *Bee*—the little vessel of ten horses nominal power (working up to double that amount) provided by the Admiralty for the instruction of the naval officers studying at the college at Portsmouth; and as having so lately enjoyed the privilege of being one of their number, I must beg to say that up to the last vacation, no experiments whatever had been carried on in this vessel "in consequence" of either statement or suggestion made by Commander Hoseason. Enquiries just made also enable me to state that the officers now at that establishment are equally at a loss to know, both at what later period such suggestions were made to them, and on what grounds they could be entitled to so great a distinction. It is a "fact" also that the letters published by the gallant commander in his letter in No. 1185 of the *Mech. Mag.*, did not, as might be supposed by the use made of them, proceed from any of the officers at that establishment; and so little justice do they do to the high talents and great experience of their real and much esteemed writer, that as one of his grateful friends I shall trust for his pardon in thus publicly expressing my strong conviction that they were never intended by him for publication at all.

Whatever experiments to ascertain the powers of either screw or paddle to propel the *Bee* may be undertaken, will be, I well know, both conceived and worked out with equal talent and truth; but it may be as well to state, that those under whose direction they will be made, are previously aware that their results cannot be made at all conclusive of the effects to be produced on larger ships. And still further, such has been found to be the loss of power and amount of friction involved in all attempts hitherto made to drive her screw with bands, that until the substitution of gearing for these, the true powers of the screw to propel this little vessel—it is felt by all connected with her—cannot be ascertained at all.

I now bid the *Bee* a dutiful farewell, and come to the edifying facts and accident connected with the *Fairy*. In your last published Number, Mr. Editor, I perceive that the "fact" of this little vessel having burst her boiler, is no fact at all. Another statement which has just as little of fact in it is, that her burden in tons is 260,—it is 320. A third, which is in the same category, is, that her valves are weighted to 11 lbs.,—they are only weighted to 10lbs. To revert, however, Mr. Editor, to this boiler, which did not burst, (in regard to which, perhaps, the gallant Commander may now be induced to exclaim "burst the boiler!") the accident which disabled it, we are told, took place when the speed of the *Fairy* was exactly thirteen knots; and immediately after we learn that the best efforts of the remaining boiler (which as it possessed half their combined amount of steam, was of course of equal dimensions with the injured one) could only produce in her a speed of "five knots, as I am a

living man." Can anything, then, be more clear and conclusive, than this "fact," viz., that the injured boiler had added the other eight? Alas! that any accident should have happened to such a boiler as this! I am told it is now never expected to do the like again! But let us see if we can at all account for the extraordinary powers so clearly proven to have existed in this marvellous boiler. Your readers know how mischievous a principle that "screw" is, and therefore will be prepared to find it had some share in the mystery. In fact, there appears to have been a sort of private understanding between the *Fairy's* screw and the aforesaid boiler—which is shown thus. We are assured upon unquestioned mathematical principles, that had these boilers been driving a paddle instead of a screw, the one which was not injured would have speeded the *Fairy* at the rate of ten knots to a "fraction," leaving, of course, but three out of the thirteen for *the* boiler produce; and as this "fact," too, stands upon the same unquestionable authority, what can be more clear and conclusive than this "fact" of "facts;" viz., that this same boiler which when driving a paddle-wheel *could* only produce a speed of three knots additional to ten, had, when driving a screw, produced a speed of eight additional to five!

"Will any person of reputation confute me here by denying the 'facts,' or by pointing out a marked error in the computation? Or has even the little *Bee* supplied me with any data more damnatory of"—what shall I add?—the screw propeller—or Commander Hoseason's qualifications to sit the self-constituted judge of its capabilities?

The public will probably come to their conclusion on the point long before he will himself have decided, whether to deny the "facts" regarding the *Fairy's* boilers, which he has so kindly collected for their edification, or to repudiate the ingenious arguments he has raised upon them; and in this grateful occupation, for the present, I think, I may as well leave him.

E. P. HALSTED,
*Captain, R.N.*

United Service Club, Pall Mall.

(*To be continued.*)

## THE EXPERIMENTAL SQUADRON AND ATTENDANT STEAMERS—SCREW TRIUMPHANT!

Sir,—I trust to your sense of justice for insertion of the subjoined extracts from the correct and faithful reports given in the *Times* of the performances of the Experimental Squadron, from which it will be seen that the *Rattler* a *screw*-steamer has carried off the palm from all her competitors.

I am, Sir, yours, &c.,

June 4, 1846. E.

Trial No. 1, May 15. "The trial of sailing was very uninteresting, except that the *Rattler*, was decidedly the best of the steam vessels."

No. 2, May 16. "All the steamers except *Rattler* were found missing to-day."

No. 3, May 17. "With the exception of the *Rattler*, whose sailing qualities have been much improved, the steamers have done nothing under sail, and have retarded the progress of the squadron considerably since leaving Portsmouth. If bound to an enemy's coast, the sailing ships, in weather like to-day, would have had to wait for them."

No. 5, May 19. "*Rattler*, the only one of the steamers in company, and she keeping her station admirably and otherwise doing well."

No. 6, May 20. "*Rattler* was the only one of the steamers with us, and making very good weather."

No. 8, May 22. "*Gladiator* and *Scourge* (steamers) rejoined the squadron this evening; *Cyclops*, *Retribution*, and *Terrible* still missing. Too much praise cannot be given to the *Rattler* for the way in which she has kept her station."

No. 9, May 24. "The great feat of the day was the *Rattler* beating *Brilliant* (frigate) two miles to windward in four hours."

Extract from a letter, dated "Chops of the Channel, May 29.—The *Rattler* is the only steamer that has been able to keep company with the sailing ships; all the others, or most of them, have been damaged. The *Terrible* lost her rudder, *Retribution* a paddle-box, *Cyclops* severely damaged; and you may confidently state that, except *Rattler*, not one of our steamers are fit for 'ocean work,' and they may retire to the Lakes, or into smooth water, as soon as they please. *The 'Rattler' has been on the weather-bow of the 'Commodore,' her station, every morning at daybreak, without a miss.*"

[Our correspondent appears to have overlooked that the *Rattler*, like the other steamers, was under sail alone all the time, and that her screw could therefore have had no share in the triumph which she achieved. —ED. M. M.]

*The Blasco Garay.*—Another trial of this frigate took place on Tuesday last, when a very correct observation of her speed was obtained by trying her over the measured mile in Long Reach, twice up and down—the last time nearly at high water. The speed through the water with guns, coals, &c., on board, was 12½ *statute* miles per hour. The oscillating engines, (the largest yet constructed,) worked again most satisfactorily.

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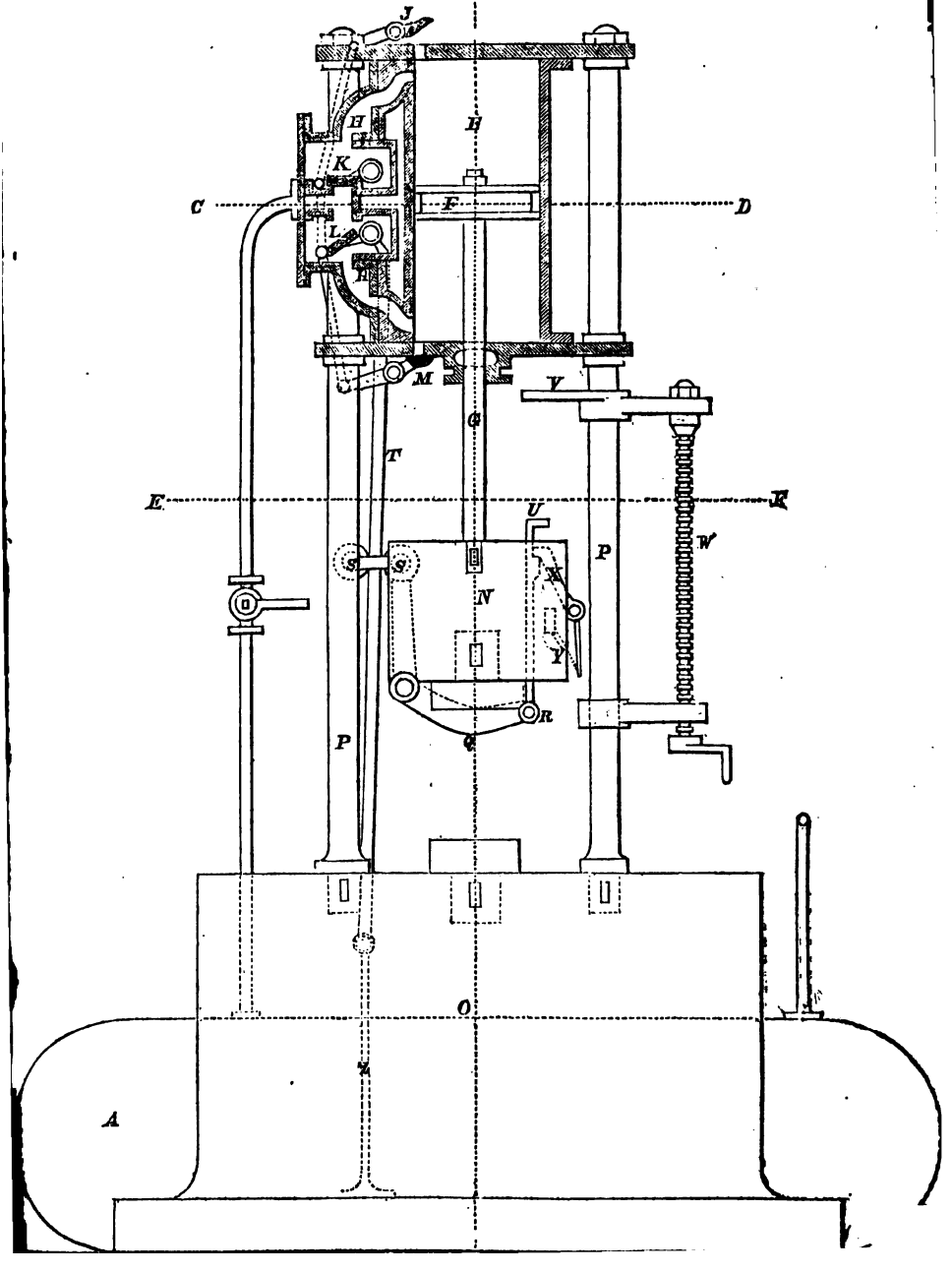
## SOUTTER AND HAMMOND'S PNEUMATIC TILT-HAMMER AND PILE-DRIVER.

Fig. 1.



## SOUTTER AND HAMMOND'S PNEUMATIC TILT-HAMMER AND PILE-DRIVER.

[Registered under the Act for Protection of Articles of Utility.—Messrs. Soutter and Hammond of the Spread Eagle Works, Limehouse,* Proprietors.]

Fig. 3.

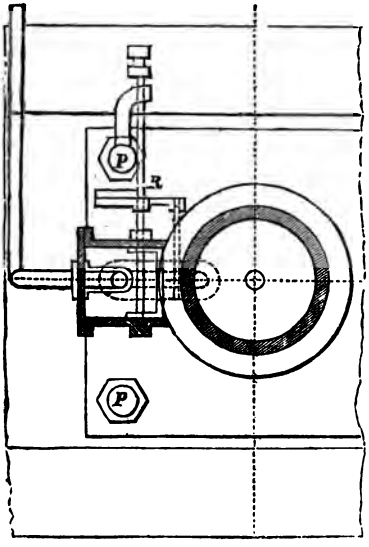
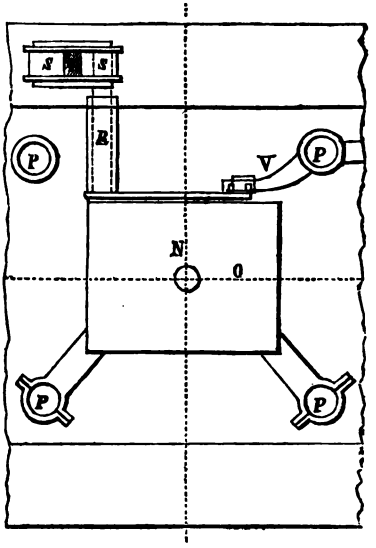



Fig. 4.




THE principal difference between this hammer and pile-driver of Messrs. Hammond and Souter, and that of Mr. Nasmyth, is that the former is worked by air and the latter by steam.

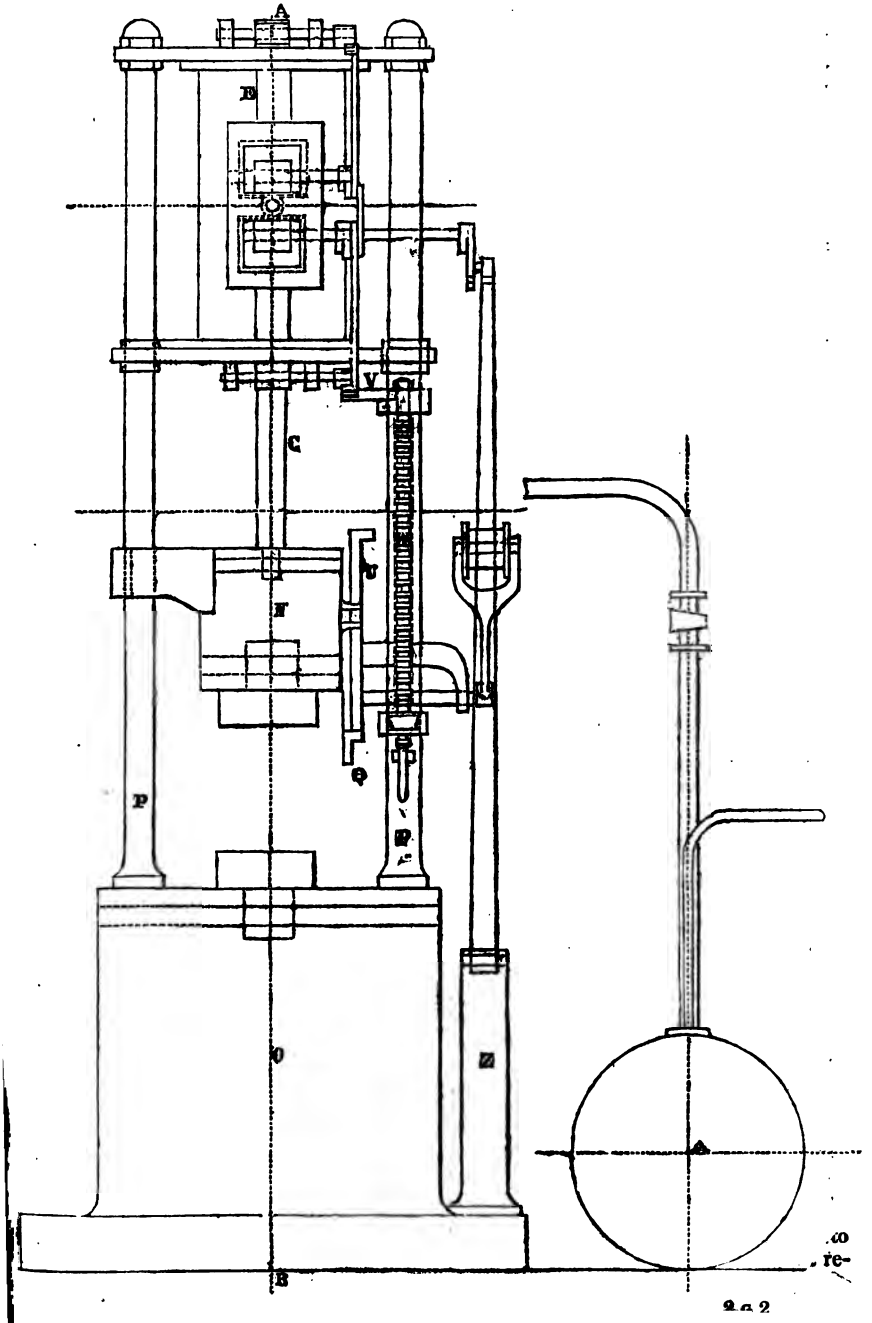
Fig. 1 and 2 are two sectional elevations of this instrument,—fig. 1 being on the line AB of fig. 2. Fig. 3 is a plan on the line CD of fig. 1, and fig. 4 another plan on the line EF.

A is an air reservoir, which is connected by a pipe with an air-pump (not shown in the engravings;) E is a working cylinder; F piston; G piston-rod; HH passages through which the air passes to and from the cylinders; J, K, L, and M, valves which open and close the passages, HH; N is the hammer; O is the anvil; P P P P, columns which support the cylinder and guide the hammer; Q is a lever which turns upon a stud attached to the hammer, and one

* A *new* firm, which this invention must serve to introduce with favour to the knowledge of the engineering public. Both the members of it have long been leading hands in the eminent establishment of Messrs. Seaward and Co., and in setting up for themselves, carry with them much practical skill acquired in one of the first of schools, and (what is somewhat rarer,) the friendship and best wishes of their late employers. We subjoin, in corroboration of what we have stated, a paragraph which appeared in the *Dispatch* of last week, and should be glad to have oftener occasion to record such instances of cordial understanding between employers and their workmen:—

"*Presentation of a Silver Tea Service to the Manager of Messrs. Seaward and Co.'s Factory, at Limehouse, by the Workmen in their Employ.* On Monday and Tuesday last, Messrs. Seaward and Co., the celebrated engineers, at Limehouse, entertained the whole of their workmen, upwards of 1,000 in number, together with their wives and families, with a trip to Gravesend, where an excellent dinner was provided for them, consisting of every substantial delicacy of the season. Adams's new cricket-ground, in the Wrotham-road, was the spot selected for the treat. Tables were laid out for the immense assemblage in the Grand Stand. The scene was a truly gratifying one, alike pleasing to the employer as to the employed. After the cloth was removed, nature was refreshed with copious libations, in which the healths and happiness of the founders of the feast (among the many loyal and frindly toasts drunk) were not forgotten. The most gratifying portion of the day's enjoyment was the presentation of a splendid Silver Tea Service to Mr. Hammond, the manager of the factory at Limehouse, by the workmen, as a token of their esteem for the universally kind feeling evinced towards them. The present was received with the same feeling it was given, and responded to in a neat and sensible speech. After this interesting ceremony, the services of the excellent band in attendance was put in requisition for the exhilarating enjoyments of the dance, and so earnest were its votaries, that, notwithstanding the thermometer indicated 80°, it was with extreme reluctance that the announcement of 'Ladies and gentlemen, the boat will not wait,' told the happy hundreds that the finale of the enjoyment had arrived."

Fig. 2.




2 a 2

end of which projects below the hammer, when it is descending.

When the blow is struck, the lever Q is forced up to the level of the bottom of the hammer, and the rollers SS, at the other end of it, move the rod T, which gives motion to the levers attached to the spindles of the valves, J, K, L, M, so as to open J and L, and to shut K and M, upon which the piston and hammer begin to ascend again.

U is a rod attached to the lever Q, and projecting above the top of the hammer; V is a stud which can be moved up and down one of the columns by the screw W, and fixed at any point so as to give the requisite length of stroke to the hammer. When the hammer has moved up the requisite distance, the top of the rod, U, strikes against the stud, V, and is thereby forced downwards, closing the valves J and M, and opening the valves L and K by means of the train of levers described before.

X and Y are a catch and spring, which prevent the rod, U, moving, until it is necessary to reverse the motion of the hammer.

Z is a spring, to the upper part of which the rod T is attached, and which allows the motion of the gear-work to be continued after the valves are closed.

### SCREW PROPELLING—MR. GACHET'S EXPERIMENTS.

Sir,—Mr. Gachet, in the description he has given in No. 1189, p. 396, of his improved screw propeller, should have stated the comparative speed obtained by the four men with his screw, when put in competition with the speed obtained by four men with oars, in the same boat; because, from the statement as it stands, nothing can be learned as to the success of the experiment, except that with four men the speed was but slow, and that with six men, (all the boat could stow,) the speed was slower still. To be sure, your correspondent states, that the experiment "nevertheless proved successful, so far as the limited power applied to it would allow;" but we all know, "that every man's *own* goose is a swan," and being an amateur conjurer myself, I can truly say, that this is frequently my own of fame, and therefore know, from sad experience, that it is necessary, to save every new future expense and disappointment, to sift a statement that recommends an innovation, even if it appear much more feasible than the one in question, which to me appears to have insurmountable defects. As I have before stated in one of your former Numbers, I think the friction of the water passing through a tube from stem to stern of a vessel *must inevitably* very much outweigh any advantages that can possibly be obtained by this plan; for the friction will be upon the whole length of the shaft as well as upon the tube, and supposing the inventor to carry out his idea of making the after ends of the tube larger than the fore end, and succeeds by this in reducing the friction, he could only gain this profit by another loss.

A vessel intended for anything like speed is tapered off, (at the depth he proposes to place the tube,) for near two-thirds of her length, until at her stern-post she presents nearly a knife edge, and therefore the ends of the tube would operate in the same manner as if the vessel was towing a round table, by a rope made fast to its pillar, which, in proportion to the tube employed in the experiment, would be 41 feet diameter to 100 feet in length, and this without enlarging the after end. As to the supposed advantages under sail, by "closing the fore ends of the tube," if this were ever carried into practice it would be found to retard the vessel much more than if the tube were left open, for the *suction* would be so great, when she attempted to move ahead, and thus leave the water in the tube behind her, that I am confident no screw, ay, not even a dozen of screws, of the present construction, would be a tithe of the obstruction.

I am, Sir, your old subscriber,

T. W.

May 26, 1846.

P.S. Upon looking over Mr. Gachet's letter, I am inclined to think that I have made a mistake in supposing he intends to increase his screw, and the diameter of the tube in proportion to the length; therefore, my supposition of 41 feet as the diameter is incorrect: but even 7 feet circumference is no joke, and if I now understand his intention, he must see that his experiment with a 6 feet tube can be no guide to the performance of one of the same diameter, and upwards of sixteen times the length.

T. W.

## OBSERVATIONS AND EXPERIMENTS ON THE CHEMICAL ACTION OF HEAT, PARTICULARLY IN REFERENCE TO DETERMINING WHETHER IT HAS NOT, AT HIGH TEMPERATURES, PER SE, AND INDEPENDENT OF THE AIR, A SLIGHT POWER OF OXYGENATION; WITH INCIDENTAL REMARKS ON THE ATOMIC THEORY, IN REFERENCE TO THIS ACTION. BY HORATIO PRATER, M.D., PH.D.

(Concluded from page 439.)

Again, in reference to iron, Berthier, from his own experiments, considers that oxygen combines with this in the proportions 6, 7, 8, 9, and that in Mosandre's experiments a new oxide is formed.* The opinion that oxidation takes place gradually, is by no means inconsistent with the fact that bodies combine by preference in definite proportions; and that affinity has a term of saturation in such proportions. It may be, indeed, in consequence of a greater facility of combination in such definite proportions, that the intermediate states of oxidation are rarely or never met with in nature, and require express experiments for their production, as in Mosandre's or Berthier's, or my own experiments explained on the views taken in this paper. I do not, however, presume to say, that the experiments I have brought forward tend to establish this point decisively, but they certainly seem to render it probable, particularly when viewed in connection with the fact, that to uphold the theory of multiple proportions as a general principle, it is often necessary to have recourse to gratuitous suppositions; such, for instance, as when the relation of the radical and oxygen is as 3 to 4 or 3 to 5 (*Berzelius, Traité*, vol. iv. p. 593.) Besides, combination is known sometimes not to be in definite proportions, as in the case of solutions in water, and in the case of sugar, or gum, in water especially, which—probably in consequence of being organic matters,—combine in still more unlimited proportions, and apparently with no other limits than those imposed by the mixture actually becoming solid when the gum or sugar is in too great proportion. And here, if it be said there is no new substance formed, this cannot be asserted when an alkali or an earth dissolves in an acid. Here is a case of solution which cannot be separated from the idea of chemical affinity, properly so called; and Berzelius calls solution "an unknown modification of affinity," (*Op. cit.* p. 585.) I have merely taken a cursory glance at this matter as somewhat connected with the present enquiries respecting the oxidating effect of heat in close vessels, to which I was led by doubting at first whether any change of weight took place in the metal tarnished under such circumstances. I therefore leave it for others to prosecute by more numerous experiments; for though Dr. Dalton's theory may be true as a general principle, it by no means follows that it should be received as true in all senses and all circumstances, or that there are not many exceptions to it.

Being anxious to approximate still nearer to the truth as to the possibility of oxidation by the specific power of a certain degree of heat, the following experiments were made: some iron filings and iron wire in an open tube, were found very visibly tarnished by exposure to a heat below redness.

*Experiment* H H.—A piece of thick bright iron wire was put into a glass tube with iron filings (a few copper turnings being also included.) The tube was hermetically sealed by the blowpipe, being about two-thirds full of filings, and thus allowing as little air as possible. Heated in the flame of a spirit lamp, and subsequently put in a crucible full of sand over a fire for seven or eight hours, the bottom of the tube had become quite blue by the heat, but had not given way. It had not increased in weight, but by comparison with some of the same filings in another part of the same tube, it was evident that oxidation had taken place, in the iron filings, and also in the end of the iron wire; the middle did not appear oxidated, probably from not having been exposed to so great a degree of heat. The copper turnings were not at all blackened or tarnished. Exposed now to the heat of nearly red hot sand, the tube burst with a slight explosion into a thousand pieces. On putting part of it, which had been blued by the heat already mentioned, into hot muriatic acid, the stain was not re-

* Berzelius, Traité, tom. iii. op. cit.

* Albumen and gelatin, have also more or less of this peculiar property of combining with water in such very great proportions. This excessive solubility in water, and power of absorbing it (as it were,) is a property often, no doubt, of very great importance in both animal and vegetable life.

moved; so that it probably depended on the lead contained in the glass and not at all on the oxidation of the iron. However, as the iron filings and part of the iron wire were slightly blackened, more than could well be assumed as due to the very small quantity of air contained in the tube, this experiment seems to support the influence that heat *per se*, even below redness, *if long continued*, has some degree of power in tarnishing iron.

*Exp.* I I.—A similar experiment was made with pieces of plumbago and charcoal. No increase or diminution of weight; and exposed to a higher heat the tube burst, although it had previously been well coated with Stourbridge clay.

I intended to have tried similar experiments in hermetically sealed copper tubes, but as glass burst so *suddenly* that I narrowly escaped an accident on approaching a red heat, I have not thought it would be prudent to put myself to any more trouble on the subject. Let us now take a general survey of all the preceding experiments:—

One conclusion that may be drawn from them is, that on heating metals in the open air or in vacuo (as near as possible,) all change of appearance—even the *slightest* tarnishing—seems to imply change of composition, *i. e.*, oxidation; for though in the case of the sixpence (Exp. A A) no increase of weight was perceptible, it no doubt had increased in weight, as the experiments with the silver lamina satisfactorily though indirectly evinced. Berzelius adopts a similar opinion: for speaking of palladium (Traité, tom. 3,) he says he has heated this metal in oxygen gas till it has acquired a blue tinge, yet he has not been able to find the slightest increase in weight. Now his balance was probably more delicate than mine; it is obvious, therefore, that more accurate balances than any yet made, would be a great desideratum in promoting the progress of chemistry. Until improvements have been made in these instruments, we can scarcely ever expect a perfectly satisfactory solution of the question, whether heat at a certain point may not contain a slight quantity of oxygen, at present inappreciable (like the oxygen, that *no doubt* caused the tarnishing of the palladium in Berzelius's experiment,) and also whether the deoxidizing effects of light may not depend on its containing a similar minute portion of hydrogen,* conclusions which in the present state of our knowledge, seem to have a considerable degree of probability. The fact rendered evident by some of the above experiments (particularly A A,) viz., that a great change of appearance may be produced by an addition of weight less than the $\frac{1}{100}$ of a grain, tends to render it probable that no change in appearance in a simple substance can take place without change of composition. This is probably always the case where only *two* simple substances are combined; and accordingly there is some grounds for being sceptical as to whether the changes of colour in sulphuret and iodide of mercury do not always denote a *very slight* change in the composition of these substances, although no such change has yet been detected—(See *Graham's Elements*, p. 151, where the idea that there is no change of composition seems rather too hastily presumed.)†

Of course, as heat itself is not ponderable, the quantity of oxygen existing in heat (if such there be) cannot be ponderable. Then, it may be said, the increase of weight of iron and loss of weight in charcoal, heated in close vessels, cannot be from the oxygen contained in heat. But this is not so strong an objection to the theory as it at first sight seems; for the quantity of oxygen contained in a red heat, continued three hours, may be appreciable to the balance, although that of the same heat continued only an hour or less, may not be so. Accordingly, we find in experiment M, that iron filings were only tarnished (slightly blackened) when kept at a red heat in a close vessel half an hour; and it is questionable whether any *appreciable* increase of weight took place, though no doubt they had increased in weight. Again, in experiment P, we find iron wire was not sensibly tarnished in a close crucible in three quarters of an hour. That nine grains of charcoal should in this period have lost $1\frac{3}{4}$ grains, is, to be sure, rather difficult to account for; but as I do not

* I shall probably endeavour to render this supposition still more probable by direct experiments, should I find leisure from other enquiries.

† As to the insolubility in acids produced on alumina, oxide of chrome, and peroxide of tin by a high temperature, this more probably depends on an increased state of cohesion effected by heat, than any loss of heat, as Graham supposes.

remember to have kept this charcoal an hour or two previously at a heat above boiling water (as was usually done in these experiments,) probably half this apparent gain should be attributed to the loss of air and moisture. At the same time that charcoal should have lost more in the same circumstances than iron *wire* gained, is what was to be expected, as iron wire has not so strong an affinity for oxygen as iron filings, and these perhaps not so strong as charcoal.* But this is doubtful.

On the same principle that we can only expect to detect oxygen in heat by *long-continued* exposure to a red heat, or a heat approaching thereto, is to be perhaps explained in experiment H H, in which iron filings were only tarnished (without increase of weight,) though kept many hours in a luted glass tube. The heat in this case could not, of course, be brought near redness. The same remark applies to iron mixed with copper turnings heated under mercury. Here the heat was not probably above that of boiling mercury, nor was it continued more than from ten minutes to a quarter of an hour.

Again, in the first (see Exp. F and E) as well as the second series of experiments (DD and EE) copper filings were found to continue free from oxidation in precisely the same circumstances that iron filings were oxidated. In Exp. DD, the steel wire was oxidated, and the charcoal lost in weight as usual, yet the copper filings were not blackened; yet when these were put into a crucible under well-dried chalk, tightly pressed down and exposed to heat, I found they were very soon changed to the black oxide. Copper, then, has, at a red heat, a strong affinity for oxygen; and if air be present, it is rapidly changed into the black oxide; but when charcoal powder, or pieces of charcoal are in the same crucible with copper filings under sand, *even though the charcoal is not in contact with the filings*, I have found by several experiments, that the copper remains as bright as it did in Exp. DD. Expts. C, F, G, sufficiently show, that in close vessels, copper filings under charcoal are not oxidated; and that this non-oxidation is to be attributed to the presence, in the same crucible, of charcoal, subsequent experiments have convinced me; and this is no doubt the reason why in Exp. EE the pieces of sheet copper were so much oxidated. In this experiment it will be seen there was no charcoal in either of the crucibles. I found, indeed, by accurate comparison, that when copper filings and well-dried charcoal powder were rubbed together and put unsand in an open crucible, the finest part of the filings were completely changed to black oxide, while the larger ones were only slightly tarnished; but this only shows that when in a finer state of division, copper has a much stronger affinity for oxygen, than when less finely divided; the same is the case with iron filings, which are visibly oxidated by a heat insufficient to oxidate iron wire, though fine. Now, in experiment DD, copper turnings, and not filings, were used; and by subsequent experiments, I have found that a piece of charcoal in the same crucible with them is sufficient to keep them from oxidating. It follows from all this, that copper, like iron, oxidizes in the best luted crucibles, if *it be not surrounded by an atmosphere of carbonic acid gas.*

Although such an atmosphere diminishes the oxidation of iron, it does not, as in the case of copper, altogether prevent it. Thus it has already been remarked (Exps. A, D, G,) that iron filings, or turnings, under charcoal powder are completely oxidated; but on repeating the experiment, at the same time, putting a piece of iron wire in the crucible filled with sand, I found, after two hours' *full* red heat, that the wire was *very* superficially oxidated (not having altogether lost its metallic lustre,) while the filings were completely black. And this experiment succeeded equally well as regards the iron wire; for filings were not tried when pieces of charcoal were merely put in the sand; none of them, except a very small piece, being near the

* At white heat, charcoal mixed with oxide of iron reduces the metal. Nevertheless, when I mixed iron filings and charcoal powder together in such proportions that I could readily distinguish the filings sparkling, I found on exposing some of this in a covered crucible not luted under sand to a dull red heat, that in an hour or so the sparkling appearance was destroyed, (the quantity of charcoal, of course, being little diminished.) Hence, charcoal, mixed *most intimately* with iron will not prevent this taking oxygen from the air, or carbonic acid; for there is reason to believe the iron must have been surrounded by an atmosphere of this. Iron filings too, as well as charcoal, decompose potass at a white heat. Now iron in the case of potass must act by affinity alone; but the charcoal may act partly by *the elasticity* of carbonic acid gas.

wire. This, though exposed to a red heat for three hours, was *only very* superficially oxidized, so that no laminæ, or scales could be rubbed off it; in fact, this wire, though the same, afforded a striking contrast to the iron wire in Exp. GG. It was certainly not more oxidized (I am inclined to think less) than the steel wire in experiment DD, where charcoal was also present, and where air was excluded as far as possible. Consequently, I think we may fairly conclude, that when charcoal is present, the oxidation of copper is completely arrested, and the oxidation of iron and steel in a great measure; and that the presence or exclusion (as far as possible) of air makes little or no difference in the amount of oxygenation in any of these cases.

But how are we to explain the oxygenation of iron and steel in an atmosphere of carbonic acid gas, particularly in close vessels; for if any air enter these, it must be in an exceedingly small quantity, and consequently there are fewer chances of its coming in contact with the metal before it is changed into carbonic acid gas.* Can red hot iron wire decompose carbonic acid gas—uniting with the oxygen and separating the carbon in the form of powder? This does not seem very probable; for burning phosphorus introduced into carbonic acid gas does not decompose it; and although carbonic acid in the solid or combined state (as in carbonate of soda) is decomposed on being made hot, and having the vapours of phosphorus passed through it, still this decomposition by no means warrants us to conclude that carbonic acid *gas* could by any means be decomposed by phosphorus; and consequently, it seems fair to conclude that this gas could not be dedecomposed by red hot iron. The decomposition of a gas is naturally to be expected as more difficult than that of the same matter in a solid state, on account of the difficulty of bringing any matter in contact with aerial particles. But when iron filings, intimately mixed with dried carbonate of soda (carbonic acid in the solid state) and heated to redness under sand, did not appear to give any evidence of the decomposition of the carbonic acid; for although the mass (examined by comparison) was rendered a very slight shade darker, still, on treating it with muriatic acid, no black powder remained undissolved. Hence the slight deepening of colour that occurred, arose in all probability solely from the filings having been changed to the black oxide, either by the oxygen inherent in heat, or more probably in this case by the contact of air.

Again, to the same effect—Berzelius says, speaking of the smelting of iron, it "appears by Sefstrom's experiments that a portion of the oxide is certainly reduced to the metallic state by the carbonic oxide at the higher parts of the furnace; lower down, where the heat is greater, the iron enters into fusion by combining with carbon."* But if carbonic oxide can reduce oxide of iron (and it will be remembered that hydrogen can do the same at a heat even below redness) surely, red hot iron should not be able to separate oxygen from carbonic oxide, or carbonic acid.†

But admitting the probability that iron cannot be oxidated in the oxides of carbon, will not iron at a red heat combine directly with the carbonic acid, or carbonic oxide? From the above passage of Berzelius, iron would not appear capable of combining with carbon under the fusing point of the metal; certainly, therefore, it cannot combine with it at a red heat; and on putting iron wire or filings mentioned above, which had been heated to redness two or three hours in charcoal powder, into muriatic acid, no effervescence was perceptible, which would probably have occurred had either of the oxides of carbon been

* On this view we should expect iron or steel wire, in loosely covered crucibles to be more oxidized than that in well-luted crucibles; but my experiments do not favour this conclusion.

* Traité, tom. iii. p. 240.

† I have only spoken of carbonic acid in the foregoing remarks on this subject; but when charcoal is heated in well-luted crucibles, it is probably rather carbonic oxide than carbonic acid that is formed. The remarks, therefore, were meant to apply to either of the oxides of carbon: if iron can take oxygen from one, it probably can from the other. Carbon, no doubt, is most easily separated, as charcoal from carbonic oxide than from carbonic acid; since hydrogen passed along with carbonic oxide in a red-hot tube makes charcoal fall. Now, we have no evidence that it would decompose carbonic acid in the same circumstances, yet it does oxide of iron, (at least at a somewhat higher heat.) This would induce us to believe, like all the above considerations, that carbon in carbonic acid has a stronger affinity for oxygen, than iron has for oxygen in protoxide iron; in other words that carbon has a stronger affinity for oxygen than iron has; *i. e.*, as *iron wire*, which is the only state that applies to the preceding observations. As already observed, when in the state of fine *iron filings*, it may be doubtful which has the stronger affinity for oxygen.

present. The acid acted on the iron as it does on the black oxide, in which state, no doubt, the iron was, whatever be the source from which it obtained its oxygen. Since the preceding observations seem to render it probable that red hot iron wire is not oxidated in carbonic oxide or carbonic acid gas, and since in all the above numerous experiments iron wire was always more or less oxidated in heated or open crucibles, *even when charcoal was present*, this view of the subject likewise renders it probable that heat has, *per se*, a slight oxidating power; but I do not say they exactly prove this point.

With reference to the objection that has been proposed to me, viz., that heat cannot have an oxidating power, or otherwise, we should never be able to procure potassium, and other easily oxidable metals, I would observe, that in order to get these metals, charcoal must be in excess, and as this has evidently, at a white heat, a stronger affinity for oxygen than the metal has, it will necessarily follow that this would continue to take all the oxygen (so very little) contained in heat, and consequently that the metal would still be obtained unoxidized, or nearly so; for it is not improbable that the surface of all metals procured by the agency of heating in charcoal powder, are *very* slightly tarnished. But whether or not, certainly the present does not seem a solid objection to the theory of heat containing oxygen.

As I have it in contemplation to pursue these researches by *another* channel at a future period, (since there is every reason to believe that the attempt to heat iron filings in hermetically sealed metal tubes would be attended with far greater danger even than in glass tubes,) I shall here only state a fact which seems in some degree to support the opinion of heat containing a small quantity of oxygen. I allude to the heat evolved by combustion being, according to Despretz's experiments, with the exception of phosphorus,* in proportion to the oxygen consumed. This fact establishes a certain relation between heat and oxygen; more than this I will not say at present, although I am inclined to think that when pursued by experiment, it may be made to support the inference that a certain portion of oxygen is an element of heat. And I shall conclude by observing, that those who do not think the preceding experiments render this matter probable, must admit, on the other hand, that there is far greater difficulty in making crucibles perfectly air-tight when a red heat is applied to them, than seems, if I mistake not, to have been hitherto imagined.

It is obvious that a red heat (and the same remark consequently applies to light) may exist without requiring any circumjacent oxygen for its support. This is shown by charcoal, and the metals being capable of being made red hot (consequently rendered luminous) in a vacuum by the voltaic battery.

But this is clearly no argument against the possibility of heat itself containing a small portion of oxygen.

Of course, if heat contain oxygen, heat must be material, though imponderable. But no philosopher seems yet to have *proved* that heat is not material, although many, as Young, Davy, Rumford, &c., have been inclined to adopt the opposite opinion. As the case at present stands, therefore, (for many eminent men still consider heat a substance, and not a quality,) there seems no impossibility in heat of a certain degree containing an appreciable amount of oxygen. The importance of deciding this point by further experiments will at once be obvious; for if decided in the affirmative, it will set the controversy respecting the nature of heat at rest, and be *proof* that heat is matter.

In order to set this matter at rest, only one more experiment seems necessary, and that is, to keep gold-leaf or fine platinum wire heated *for two or three hours* in vacuo by the voltaic apparatus.

* Does the encreased rapidity of combination here compensate for a less quantity of oxygen? This seems probable.

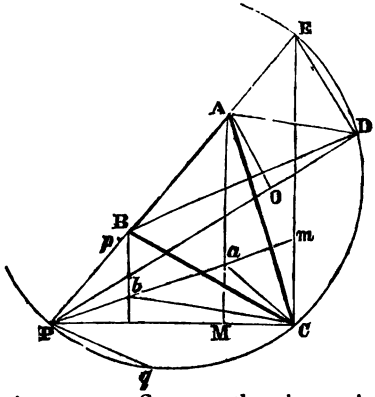
## THE PROBLEM IN ORTHOGRAPHICAL PROJECTION (P. 297.)—ANOTHER SOLUTION.

Sir,—In your Number, 1184, page 297, you have inserted from a foreign work a solution of an important geometrical problem proposed by Mr. Cockle. The solution you have given is certainly a very elegant geometrical investigation. As, however, you have spoken of the problem with some degree of interest, I have considered the subject, and forward you a solution of my own. If you approve of it as concise and correct, I

should be glad if you would allow it a place in your pages.

PROBLEM.—*Given two triangles, one in magnitude and position, and the other in species; to find a plane upon which if the first be orthographically projected, the projection shall be similar to the second.*

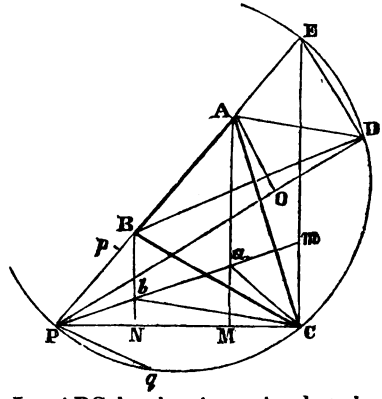
Fig. 1.




ANALYSIS.—Suppose the given triangle, ABC, projected orthographically as required, and let *ab*C be the projection. Let CP be the line of intersection of the two planes, and suppose the plane of projection moved round so as to coincide with the original plane as in the figure. Then A*a*M, B*b*N will be perpendicular to CP; also AB, *ab* produced will meet CP in the same point, P. Construct the triangle PAD, similar to P*a*C, and draw AO perpendicular to PD, whence by similar figures PO : PD :: PM : PC; therefore, since the perpendiculars MA, OA meet PA in the same point A; it follows that lines drawn from C and D, perpendicular to PC, PD respectively, would meet PA produced in the same point. From this it appears that the point P is the extremity of the diameter of a circle, passing through D and C, and having its centre in AB.

But BD being joined, we have
DA : C*a* :: AP : *a*P by triangles,
:: AB : *ab*, and angle BAD = angle *ba*C; ∴ the triangle BAD is similar to C*ab*, and is ∴ known in species, and it is applied to AB; ∴ the point D is a known point. This, then, gives the following construction :—

Fig. 2.




Let ABC be the given triangle to be projected; upon BA describe the triangle BAD similar to the required projection, the angle BAC being to be projected into BAD, and the angle ABC into ABD. Through the point C D, describe a circle whose centre shall lie in AB, or AB produced. Let PE be the diameter of this circle; join PC; this will at once give the intersection of the required plane of projection. Draw AM, BN, perpendicular to PC. Join PD and make the angle CP*a* = the angle APD, and join C*a*, C*b*. C*ab* will be the projection required. Though the demonstration may be plain from the analysis, it may not be amiss to state the proof. Join DE, EC, and draw AO perpendicular to PD, then because ED is parallel to AO.

∴ PD : PO :: PE : PA :: PC : PM;
also PO : PA :: PM : P*a*,
by equiangular triangles PAO, P*a*M.

∴ PD : PA :: PC : P*a*, and ∠APD = ∠*a*PC;

∴ △PAD is similar to *a*PC; whence *a*C : AD :: *a*P : AP :: *ab* : AB;

∴ △*ab*C is similar to △ABD, and it is the orthographic projection of ABC. Which was to be done.

*Corollary* 1.—If we wish the projection to be further off, we need only produce *ec* to any length, and draw a line equal and parallel to CP, meeting AM, BN produced; and then describe the triangle P*a*C as before.

*Cor.* 2.—The cosine of inclination of the planes is evidently $\frac{Ma}{MA}$. Or if P*a* be produced to *m*, and a line were drawn through *m* parallel to CP, meeting AP in *p*, then placing a chord P*q* = P*p*; the angle EP*q* would be the inclination required. The cosine of inclination may also be expressed thus :—

$$\text{Cos. Incl.} = \frac{Ma}{MA} = \frac{\tan.\, aPC}{\tan.\, EPC} = \frac{\tan.\, EPD.}{\tan.\, EPC}.$$

*Scholium.*—If it be enquired whether the line EC drawn from the other end of the diameter to C, does not also determine a plane of projection for the problem, it must be replied that the intersection EC would determine a plane in which BAD being placed as the primitive triangle, would have the given triangle BAC for its orthographic projection. Or the point E may be considered as to be used thus: if BAD be the primitive triangle given in position, then ED being joined will give the intersection of a plane upon which BAD will have an orthographic projection similar to the triangle BAC, and generally, that extremity of the diameter is to be used which gives an intersection lying farther from the diameter of the circle than the line drawn from the same extremity to the vertex of the other triangle. Thus in the problem the extremity P, and the intersection PC belong to the triangle ABC as the primitive, and the extremity E and intersection ED belong to the triangle ABC. And it may be easily shown from Cor. 2 that the inclination of the planes will be the same whichever be the primitive triangle. We may finally remark that any other way of placing the triangle ABD, against the given primitive ABC, would give an intersection parallel to PC, which would therefore be an identical result.

The most simple practical way of making the angle CP*a* equal to DPA in the construction, will be to take an arc C*d* equal to the arc DE, or E*d* equal to CD, whichever may be less than a quadrant, or not too near a semicircle, and join P*d*, meeting AM (by production, if necessary) in *a*; or else draw from D a line perpendicular to CP, meeting the circle in *d*, and join P*d*. Also, it may be observed, that if the triangle ACD be constructed on the other side of AB, the same projection will be obtained by this construction, but it will fall upon the opposite side of CP.

I have added those remarks which I think needful for the full comprehension of this construction, though I am sorry to trespass on your valuable room.

I am, Sir, &c.,

MUTIUS.

Dorset-place, June 4, 1846.

## TATE'S EXERCISES IN MECHANICS AND NATURAL PHILOSOPHY.*

PRACTICAL SCIENCE has too long been a bye-word—another name for error, ignorance, and charlatanism. No matter how crude the notion, inconsequential the argument, or absurd the result, it has been sure to be "received as gospel," if propounded with an air of pretension and supported by vague and irrelevant argument—and if clothed in a few trivial symbolic equations, its reception was certain, because the conclusion was "demonstrated mathematically!"

A new day has dawned upon us, and we entertain a hope that the clear and steady light of genuine science will hereafter guide our practical operations. The "rule of thumb" has had its day; and a long, dreary, darkling day it has been. A movement in the right direction has commenced; and men of the highest mathematical genius are devoting their energies to the solution of those physical and geometrical problems, that are of such paramount importance to the civil and military engineer.

Our space, just now, will not allow us to go into the history of this movement, interesting and tempting as it is. Astronomical physics had the almost exclusive devotion of mathematicians till a recent period; the undulatory theory of light then divided the empire with the *systeme du monde;* and now, as a *finale*, the vulgar terrestrial questions which affect our own existence and social comforts, engage a portion of the *intellect* of the most energetic of our scientific men. Yet it must be confessed that as a general rule, those who are at the head of the engineering profession look coldly and discouragingly upon the labours of the man of science; and that "theory" is with them rather a term of reproach than of approbation. However, this is the history of every improvement both in art and science, and

* Exercises in Mechanics and Natural Philosophy, and an Easy Introduction to Engineering for the Use of Schools and Private Students, containing Various Applications of the Principle of Work, the Theory of the Steam-engine—with simple machines, theorems and problems on accumulated work,—the equilibrium of structure, with the theory of the arch; the pressure and efflux of fluids, calculations on railway cuttings, &c., &c. By Thomas Tate. 12mo. pp. 144. Longman.

even in social life; but another race springs up, the "conservative principle" gradually dies away, and the very memory of great advocates of "letting well alone" are deservedly (and for the mere shame which their conservatism creates) consigned to the tomb of the Capulets. Would that some of our leading architects and engineers could foresee their own fate! They would encourage, though they could not (from want of the requisite preliminary mathematical learning) take part in the great efforts which scientific men are making, to base their practical operations upon unerring scientific principles. The next step in point of reputation to actually carrying out those investigations themselves, would be the honest and earnest encouragement of those who are ready to devote their talents and acquirements to such a purpose. We lament to say, however, that instances of such co-operation are the exceptions to the rule, rather than the rule itself, which govern the intercourse of some of our most eminent practical men with men of science. It is no shame to an engineer or an architect, that his mathematical training was neglected by those who had the forming of his professional mind; and though he must feel it to be a misfortune, it is still most ungenerous that he should wish to involve his professional posterity in the same misfortune. A noble and liberal mind would rejoice in the future elevation of his class, even though his own fame may be somewhat dimmed by a comparison with that brighter condition to which we are rapidly approaching.

Since the establishment of our own periodical, we have laboured with ceaseless anxiety to raise the standard of acquirement and to develope the latent talent which we knew existed amongst the operative classes, and the superintendents of actual construction amongst that class of men who are the *real* (though not always recognised) *inventors* of a large majority of the inventions that have conferred so much honour on the age, and so much advantage on the general English public. We are proud to reflect, too, that we have ever encouraged and aided to our utmost power, those who were struggling against adverse circumstances to bring their claims before the public. We do not claim to have been always correct in our anticipations of the value of an invention; but we do claim to have aided the inventor honestly, faithfully, and, as far as possible, effectively. We have the satisfaction to know that our labours have been *useful*, and that we have contributed in some degree to raise the intellectual standard of the class to whose interests we were more immediately devoted. Intellectually, they are now a different class from that which we originally addressed; and in our own pages we have kept this altered condition in view, in the character of the articles themselves.

Since we first set the example of attempting to furnish professional and amateur artisans with the means of studying the *principles* of their processes, we have been gratified with the sight of a growing philosophy and literature devoted to their special use. Foremost in this class of works came Dr. Gregory's "Mathematics for practical Men," which was almost simultaneously followed by Dupin's gossiping, but *attractive* work, of which the first volume was translated into English by Dr. Birkbeck. Men of science began to turn their science into practical channels, and we have now before us many works on the principles of mechanism under a philosophical aspect. It is, however, without doubt, to the energy and ability of Poncelet, that the diffusion of real, precise, and applicable modes of applying mathematics to the statics and dynamics of structures and machines is due. He eschewed the discursive and vague mode of instruction which Dupin introduced with so much of *éclat* into the French *salles d'étude* of the practical classes. His example has been followed in some degree in this country; and we are now in possession of a *few* (though how few!) that vie with the best productions of France and Belgium. We especially refer to the works of Willis and Moseley;* but we would not omit to men-

* The *Principles of Mechanism*, by Robert Willis, M.A., F.R.S., Jacksonian Professor of Natural and Experimental Philosophy in the University of Cambridge, 1841.

*The Mechanical Principles of Engineering and*

tion with adequate commendation, Whewell's "Mechanics of Engineering." In fact, but for the too off-handed, and consequently ill-digested and necessarily incomplete development which Dr. Whewell gives to everything he undertakes, he might have made that work a standard one. He has done sufficient to take away the reputation from any one who may write a more complete treatise, whilst he has done too little to contribute much to his own reputation, or to render his work one of more than ephemeral existence. We would earnestly impress upon Dr. Whewell the importance of remodelling his book and completing his own obvious design. Few men are more competent to the task—except, possibly, in the quality of patient perseverance.

But works of this class are only adapted to the wants of a very limited number of professional persons; inasmuch, as the discreditably defective state of our system of mathematical education in England renders it impossible, for more than perhaps one in a thousand, to follow these authors' reasonings. What is still more to be regretted is, that the cultivation of mathematical science, to which we have before referred, is discouraged by nearly all those who are looked up to as authorities in the twin-sister professions. The consequence is, that instruction must be commenced at a point greatly below what it might be, and conveyed in a form to which the teacher cannot give his entire approbation, though compelled by the circumstances of the case to adopt it. It is a far more difficult task for the man of science to *write down* to the level of undisciplined minds than to instruct the man who has at least made himself master of the ordinary elementary acquirements that are needed as a preliminary. None, indeed, but most perfect masters of the subject, and the most accomplished thinkers, ever succeed in such an attempt. Yet, strange enough, it is in composing such works that the men of most limited acquaintance with every subject, thrust themselves before the public! We could offer instances without end, in almost every age and on all subjects connected with our own profession, of books written with the professed object of simplifying the acquirement of knowledge, of the first principles of which the authors themselves did not possess even an approximately clear idea. Very often, even gifted men, like Dupin, have been themselves led to fritter away the verities and connections of science to attract a moment's attention from the gaping crowd; and they have vainly flattered themselves that the acclamations of the moment betokened their having sown the seeds of permanent science amongst their *claqueurs!* No—science is not THUS "diffused."

We have some satisfaction in the midst of the verbiage that is daily issued for "popular use," in seeing men of ample science, who also understand how to *teach* science, coming forward in the cause. Amongst them we are glad to see our old correspondent, Mr. Tate. As an analyst, we have before spoken of his labours (vol. xliii., p. 165) in such terms as we considered his work, in strict justice, demanded of us; but we confess, that from our experience of the labours of other eminent men in the field which he has now chosen, we felt some degree of anxiety lest he should here have failed to maintain his position. The feeling was, however, soon removed; for it became evident that the work was conceived in the "right spirit," and executed with a master's hand.

In the first place, it is a work for which the author claims no high pretensions beyond that of *utility;* and in the present state of things, it is calculated for utility to a large class of readers. He has succeeded in rendering clear to every capacity, and to men of *very* limited acquirements, the correct principles of almost every branch of engineering; and he has given, moreover, numerous applications of those principles to all the more usual and important cases that come under the consideration of the practical man. The investigations are conducted for the most part in an arithmetical

*Architecture*, by the Rev. Henry Moseley, M.A., F.R.S. Professor of Natural Philosophy and Astronomy in King's College, London, 1843. For Review of this work, see *Mech. Mag.* vol. xxxvii., page 495.

*form*, whilst *in essence* they are of the general character of the algebraic method; for every reader will see at once, and be *forced* to see it, that the reasoning is not at all limited to the particular case that is laid before him by the author. In fact, had this work been published at the time of the composition of our *Miscellanea Mathematica*, No. IX., it would certainly have been recommended as an important praxis in passing from the study of arithmetic to that of algebra.

In the second place, the arrangement of the work is in accordance with the natural sequences of the truths themselves which are developed in it. Little as general readers may suspect it, this is one of the rarest of all qualities in elementary works, and even in works of a far more pretending character. In the minds even of the educated, and often in the mind of the profound scholar, knowledge is rather a confused heap of truths, without classification, than arranged with that systematic precision which places every fact in juxta-position with the others to which it is naturally related. This is the genuine philosophy of science; and this is a very prominent character in Mr. Tate's book.*

In the third and last place, there are some of the views and applications which may be considered in all strictness, as new, whilst old and new are exhibited with a like degree of perspicuity. We think, indeed, that the several sections of the treatise on the subject of WORK, in respect to which we are glad to see Mr. Tate adopts and enforces with ability the views of Professor Moseley, may tend to give precision of idea to students of a far more advanced class than those for whom the author professedly writes. He gives likewise a new formula for finding the (approximate) centre of gravity of an arch much more simple than that in common use. His chapters on the "simple machines" are very neat; and those on "equilibrium" cannot fail to place in a clear light a subject to which a great deal of unnecessary and artificial embarrassment is often given by elementary writers. We have ourselves long felt convinced that the fundamental principle of the "composition of forces" is that one *axiom* which requires to be added to the Newtonian, *as an axiom to be admitted from experience or experiment*. The "sufficient reason" of Leibnitz, which in some shape or other enters into all the demonstrations of the parallelogram, *is not a logical reason*. But we are digressing.

In conclusion, we most cordially recommend Mr. Tate's little work to our readers in general. It meets a real want in the literature of engineering, and is calculated to serve effectively that cause in which for nearly a quarter of a century we have ourselves assiduously laboured—the diffusion of *sound* knowledge amongst practical men.

* "Dr. Hutton, in his best days as a preceptor, used to enforce his notion of the value of depositing scientific truths in the mind, by a familiar illustration: 'Sir, you must arrange the whole by scientific rules, and then so lodge it in the memory, that you can draw it out as you want it, just as a lady can draw a thread or silk from her housewife, either by a single thread, or a skein, as she pleases.'"—*Dr. Gregory's Hints for the use of Teachers of Elementary Mathematics, and of Self-taught Students:* 1840, p. 6.

This illustration, though somewhat quaint, is a most impressive one, and is characteristic of the habitual symmetry of Dr. Hutton's powerful intellect.

## IRON STAND FOR COFFEE, CHOCOLATE, AND OTHER GRINDING MILLS.

Dear, Sir,—I herewith send you a design for an improvement in mills for grinding coffee, cocoa, drugs, spices, &c., particularly suitable for use on board ships, and also applicable for small shops, domestic use, or any situation in which saving room is of importance.

It will be perceived from the engraving that it may be fixed against any flat surface by a few ordinary screws, and has the advantage of the fly-wheel occupying no inconvenient room, being almost close

to the surface against which the mill is fixed. The winch is removable at pleasure, thereby saving the room occupied by the handle when not in use. If it be more desirable to have it easily removable on board ship, two bolts and nuts may be substituted for the screws, by which it is represented to be fixed; by unscrewing the nuts, the mill can be instantly removed from the surface, against which it is fixed for use.

I could send you, Mr. Editor, if acceptable, several designs for works of utility, but as some of them have relation to my own business, I have been deterred from doing so by the fear that I should be thought guilty of making use of your pages as a medium of doing that which I have a fastidious dislike to, (although at present so fashionable,) viz., puffing my own inventions; but a more mature consideration of the subject has convinced me that this is a false delicacy. When we are acquainted with a generally useful thing, it is our social duty to publish it, even if we subject ourselves to the suspicion of interested motives by so doing. I know no good reason why we should refuse to receive truth from those interested in its diffusion. We are justified in receiving their statements with caution, not in rejecting without examination, or we should deprive ourselves of a fruitful source of knowledge.

Yours respectfully,

ALFRED SAVAGE.*

43, Eastcheap.

NOTE ON INFINITE SERIES, BY ℭ, IN REPLY TO PROFESSOR YOUNG.

Sir,—The "Young" planet invites me into your interesting field of view to scatter some moon-beams on the mysterious subject of Neutral Series, which has, it seems, produced a sort of dimness about the focus of the telescope. To a careful observer, free from occular defect and peculiar visions of his own, it will be seen that the sum of an infinite number of terms of the series is in each case deduced on the not-to-be-allowed supposition of the existence of a concluding term. The value of an infinite series differs most essentially from the summation of a finite number of terms by the inadmissibility of all notions of a stop or concluding term.

We find that the expression for the sum of $n$ terms of a series, generally presupposes the existence of the succeeding terms $n+1$, $n+2$, $n+3$, &c.; and it is the sum of these that constitutes the correction for $n$ terms supplied by the "Young" planet. The algebraic expression for this correction when $n=\infty$ may be infinitely great in divergent series, or it may become a finite value in neutral series; but it must nevertheless be neglected whenever it is required to express the complete value of the series. If $\infty$ terms be supposed to comprehend the *entire* series, it is manifestly absurd to calculate on the assumed existence of the terms, $\infty+1$, $\infty+2$, &c., beyond the *ad infinitum*, and the expression which develops into these terms must be rejected, not as having no analytical value, but solely on account of the suggested terms having no admissible existence in the extreme case of infinity.

I have so many inequalities to attend to, and so many perturbations to encounter, that I must politely beg to be excused from entering on a formal discussion, so far calculated to neutralize the practical instructiveness of your useful pages. The "Young" planet and myself may naturally enough be in opposition, but it is quite impossible that an eclipse can result on either side, and the phenomenon cannot therefore be very interesting to your terrestrial mathematical spirits who may not necessarily be enthusiasts in analytical magic. Yours truly, ℭ.

GILBERT'S ECONOMIC MARINE SIGNAL LAMP.

[Registered under the Act for the Protection of Articles of Utility. Mr. E. Gilbert, of Falmouth, C. E., Inventor and Proprietor.]

At the last meeting of the Royal Cornwall Polytechnic Society, the Committee on naval architecture made the following report on this lamp:—

"Having witnessed the manner in which this lamp is lighted, replenished, and extinguished, in one that had been used more than 550 times, they deem this invention of such importance, that they would recommend that a description of it be printed in the next report.

"In testing its merit, they caused a blue light, such as is supplied to H.M.'s ships, and this lamp to be burned simulta-

* We are always glad to hear from Mr. Savage, and hope that none of the "false delicacy" to which he alludes, will tend to diminish the frequency of his communications. We may be pretty sure that anything a person of his information and intellence deems worth telling is worth knowing.—ED. M. M.

neously, and at a distance from each other and themselves, and are of opinion that the lamp is equal to it in intensity, much superior to it in duration, and more easily ignited. This trial was made on a wet and windy night.

"The judges regret that they cannot award Mr. Gilbert a silver medal, though he so well merits it, in consequence of its being contrary to the rules of the Society to make any award to that which has been already patented or registered: all they can do is to congratulate their fellow-townsman on his perseverance and success, and most strongly impress on all those whose duties are on the waters, the utility of the 'Economic Marine Signal Lamp.'

"They would also remark, that it is well adapted for a torch for land purposes."

We hope to be excused for anticipating the Society in giving the "description" recommended by their committee to be drawn up, and trust that, like the Society of Arts, our friends of the Royal Cornwall Polytechnic Society will, ere long, see the propriety of revising that part of their regulations which excludes patented and registered inventions from participating in their rewards.

Fig. 1 is an external elevation of this signal-light or lamp, and fig. 2 a similar elevation with part of the outer side removed, in order to show the interior construction.

Fig. 1.

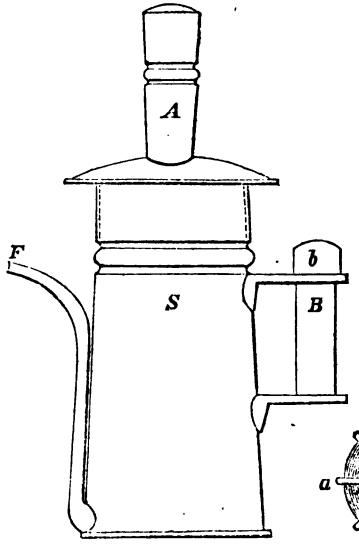



Fig. 2.

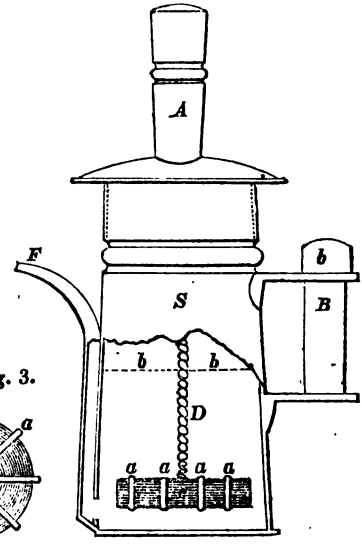
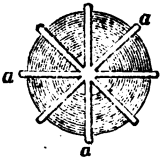



Fig. 3.



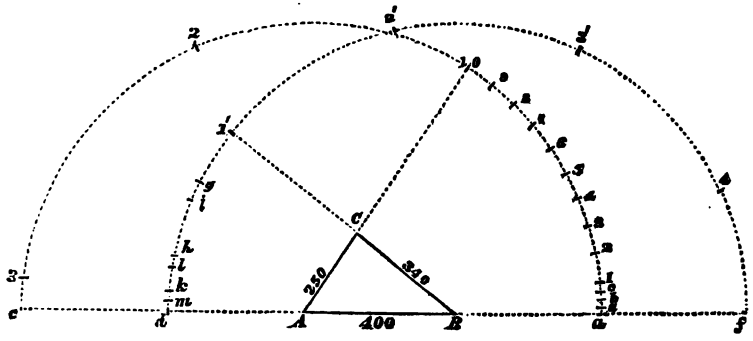

S is a vessel of tinned plate (or any other suitable metal) for holding the spirit or other liquid for producing the light. A, a cover nicely fitted on to the top of S, as shown by the dotted lines, to prevent wastage or evaporation. To this cover there is a handle, which serves for holding the wick-holder, or stem, hereafter described, and is held in the hand while the light is exhibiting. The wick, as shown in fig. 2 at C, and separately in the plan, fig. 3, is composed of metallic wire, intercoiled with thread of cotton, or any other fibrous material, or of threads formed of wire and cotton, or other fibrous material intertwined together. D is a spiral stem of wire, by which this wick is attached to the handle on the cover. When the wick is so attached to the stem, and placed into the spirit-holder, it should reach nearly to the bottom, as shown in fig. 2. The dotted line, *b b*, shows the usual depth of the illuminating liquid in the holder.

I also attach to the wick some pieces of metal wire, passing across the illuminator above and below, as shown in figs. 2 and 3, at *a a a a a a*, and placing beneath those cross wires pieces of cotton-wick, linen, hemp, tow, or any other fibrous

matter for the purpose of holding a portion of the inflammable liquid, and also for facilitating its lighting. To the side or front of the spirit-holder there is attached a spout, F, for the purpose of replenishing it when requisite. B, figs. 1 and 2 are hollow socket-handles, by which to carry or hold the vessel S. The inventor uses this hollow handle also as a case or match-box for containing matches, fuses, portfires, or any other thing that will answer the purpose of igniting: *b* is a cover for receiving the same.

## M. DE LAGNY'S METHOD OF MEASURING ANGLES, WITH ITS APPLICATION.

M. De Lagny devised a new method of measuring angles which he called *Goniometry* (see that word in *Hutton's Dictionary*:) it consists in measuring with a pair of compasses the arc which subtends the angle, in the following manner: — From the angular point as a centre, with a pretty large radius, describe a circle, produce one leg of the angle so as to cut off a semicircle; then to ascertain what part of the semicircle the arc is which subtends the angle, proceed in this way:—




Take the extent of the subtending arc with a fine pair of compasses, and apply it to the arc of the semicircle to find how many times it is contained therein; if there be a small part remaining, in a similar manner, take the extent of this remaining part, and apply it to the first arc to find how many times it is contained therein; if a small part again remain, apply it in like manner to the first remainder: again apply a third remainder in the same manner to the second, and so on, (always remarking how many times the last remainder is contained in the next preceding one) until nothing remains, or until the remainder is too small to be so applied. Then commencing at the last and returning backwards, make a series of fractions of which the numerators of each are 1, and the denominators the number of times which each remainder is contained in its next preceding remainder, together with the last fractional part which is derived from the following remainder; the last fraction thus obtained will show what part of the semicircle, or 180°, the angle proposed to be measured is.*

The method of measuring angles, though very simple, and certainly very accurate, has not, it is believed, been generally† noticed by writers on

* The prescribed operation of measuring is precisely that of finding the greatest common measure of two numbers; the noted number of times one arc is contained in another, corresponding with the quotient in that process, and the remainder with the remainder. The final expression of the numerical value of the angle is obtained by the method of continued fractions—or as they are often now termed, convergent fractions. The principle of this method may be studied from most of our modern works on algebra. It is almost unnecessary to remark that the length of a straight line may be found from having any given length as a standard, in precisely the same way, with great accuracy. With the straight line and circle, however, this application of De Lagny's process terminates; there being no other curve that admits of such mensuration—and for obvious reasons—Ed. M. M.

† It has been given in several of the later editions of Hutton's "Course," into which it was introduced either by Dr. Hutton himself, or by Dr. Gregory, to whose care he entrusted the work. As our Magazine will probably be seen by many who have not the means of consulting the only Eng-

trigonometry; their silence on the subject may plead an excuse for the appearance of this article.

In the following application of the mode, the lengths of the sides are taken from a quarter-inch scale, and the semicircle in each case was described with a radius of 760 taken from the same graduation. To save room and trouble only one figure is given.

(1.) The three sides of a triangle are 400, 340, and 250, what are the angles?

Having laid down the triangle, produced its sides, and described the semicircles as in the marginal figure; first, to find the angle BAC, take the arc *ab* and apply it three times on the semicircle *a b c* as at the points marked 1,2,3; take the remainder 3*c*, and apply it on *ab* nine times, as at the small figures 1,2,3,4,5,6,7,8,9; the remainder 9*b* apply just four times to *a*1, as at *abc* 1. Hence the series of quotients is 3, 9, 4; consequently the last arc *aa* is $\frac{1}{4}$th of the arc *a*1, and this arc $= \frac{1}{9\frac{1}{4}} = \frac{4}{37}$ths of the arc *ab*; and *ab* $= \frac{1}{3\frac{4}{37}} = \frac{37}{115}$ths of 180° = 57° 54′ = ∠BAC.

Again, to find the ∠ABC. Proceeding in the same manner, the arc *de* is applied four times to the semicircle *def* as at the points marked 1′, 2′, 3′, 4′; 4′*f* the remainder is contained *once* in *de*; *ge* the remainder may be applied *twice* to the arc *dg* as at the points *hi*; the remainder *ig* is contained *twice* in *dh* as at *kl*; the remainder *lh* is contained exactly *twice* in *dk* as at *mk*. Here the series of quotients is 4,1,2,2,2: the arc $dm = \frac{1}{2}$ of arc *dk*; $dh = \frac{1}{2\frac{1}{2}} = \frac{2}{5}$ths of arc *dh*; $dh = \frac{1}{2\frac{2}{5}} = \frac{5}{12}$ths of arc *dg*; $dg = \frac{1}{1\frac{5}{12}} = \frac{12}{17}$ths of arc *de*; and $de = \frac{1}{4\frac{12}{17}} = \frac{17}{80}$ths of 180° = 38° 15′ = ∠ABC. Hence the ∠ACB = 83° 51′, only 2′ less than its value obtained by the common method; see Gregory's Trigonometry, p. 23.

(2.) The three sides of a plane triangle are 500, 400, 300; what are the angles?—In this example, the sides of the triangle are obviously as the numbers 3, 4, 5. It is known, therefore, that it has a right angle, and we have only to find one of the acute angles which will determine the other.

By following the above process, we have 3, 2, 1, 1, 7 for the series of quotients; hence the first arc is $\frac{30}{139}$ths of 180° = 53° 1′, one of the acute angles; the other is 36° 59′.

(3.) Given the three sides = 750, 340, 592, to find the angles. Here one series of quotients will be 3, 1, 1, 1, 2, 4. Hence the first corresponding arc is $\frac{85}{127}$ths of 180° = 49° 36′. In the same manner another series of quotients is found to be 7·20 and the first arc = $\frac{20}{141}$ths of 180° = 25° 31′. Hence the third angle = 104° 53′.

(4.) The three sides of a plane triangle are 760, 429, and 727; what are the angles? By a similar process we find 2, 1, 1, 1, 1, 1, 3 for one series of quotients, and the first arc = $\frac{88}{151}$ths of 180° = 68° 41′; the second series of quotients is 5, 2, 4, 2, and the first arc = $\frac{28}{159}$ths of 180° = 33° 16′. Hence the third angle = 78° 3′.

By referring to Gregory and Bonnycastle's Trigonometry, from which the above examples were taken, it will be found that the third angle determined by the foregoing method differs, though not very considerably, from that found by trigonometrical calculation. It should however be observed, that the distances in the above cases were taken with a pair of *common compasses*. De Lagny used *fine* compasses: hence, it is probable that if finer compasses were used in the operation by a more dexterous hand, the disparity between the above results and the answers in the book would be much less. The student is recommended to try how near he can bring the results alike: the mere working of the above examples will make him fully acquainted with the method: he will find no difficulty in it, and if we mistake not, a little practice will make it interesting to him.

This method of measuring angles, though very little known, cannot fairly be considered a mere speculative curiosity. In many cases it enables us to find the measure of angles with tolerable accuracy, without either trigonometrical tables or scales of tangents, sines, &c. In the ab-

lish work (as we think) which contains it, we willingly give insertion to the neat and perspicuous statement of the process furnished by our valued friend "Exoniensis."—Ed. M. M.

sence of these adjuncts its convenience will readily suggest itself: its application may often be practically useful to surveyors, engineers, and other, when other expedients are not at hand; perhaps it may also sometimes be *satisfactorily employed as a test for the correctness of calculation.* With a pair of compasses, a scale of equal parts, and a knowledge of vulgar fractions, the measure of angles may thus be ascertained. The angle at which two lines meet might generally be found by this simple process on the ground: in some instances the angles of a close of land might be determined by the chain only; that is, the semicircle might be described, and the arcs set off with the chain on the spot.

EXONIENSIS.

June 1, 1846.

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SCREW PROPELLING—OBSERVATIONS ON THE LETTERS OF COMMANDER HOSEASON —BY CAPT. HALSTEAD, R.N.

(Concluded from page 448.)

Sir,—If I remember right, I left the great *annihilator* of the screw, himself, in rather a perplexing case;—a self-impaled victim on his own "*edifying*" dilemma—doubting on the one hand, if his statement of the "five knots" of the *Fairy* were such an one as he durst "step forward" to substantiate; and on the other equally at a loss whether, by denying a "fact," vouched for on faith of his being "a living man," he would venture so seriously to bring into question the character of his own identity: In short, endeavouring to decide whether his next appearance for the amusement of the public should be as "ghost or no ghost;" and as I really feel this to be a melancholy position for a poor being, of whatever order of existence, to have placed itself in, I will withhold from putting the "screw upon him" at its "maximum number of revolutions;" but conceiving that, he may even find that it can exert quite "pressure enough," when working even very "expansively," will pass on from the case of the *Fairy* to that of the *Dwarf;* merely observing, *en passant*, as to the paragraph of the commander's letter which treats of the comparative powers of *Fairy* and *Megæra*, that I am unable to make out any meaning in it, unless it be that it informs us that "indicators" are instruments affixed to the cylinders of steam engines for the purpose of discovering the weights upon the safety valves of their boilers!

But of the *Dwarf*—as I am unaware of possessing sympathies, in common with abortions of any sort, I shall dismiss her with this brief notice, that under the able head and hands of the chief engineer of the navy, this little vessel has been turned to more extended use than her proportions would at first seem to have allowed of, and has been made the subject of an extensive and important series of experiments. Four different screws of equal diameters (5 ft. 8 in.), but of differing lengths and angles of pitch (varying from 24° to 36°,) were each subjected to four reductions of their surface—and a set of trials made upon each reduction of each screw, the tabulated results of which have informed us with almost the precision and certainty of a law—that the screw of comparatively fine angle of pitch, small surface, and driven at high velocities, will give a more useful effect, less slip, and less vibration, than the screw of larger surface, and coarse pitch, driven at lower velocities. And with the further remark, that we here see, 16 out of the 22 screws charged against the *Dwarf* accounted for, I beg to inform her, that "she may go;" and summon the *Phœnix* to take her place; a vision, if not of another abortion, at least that of a nondescript.

But neither has the *Phœnix*, too, Mr. Editor, been without her use, though, I must admit, in a very expensive shape. The Admiralty in their liberality made this vessel over to the tender mercies of parties, who not only illustrated on her their peculiar ideas of uniting the useful with the beautiful in the alterations she underwent in hull, but who also, as regarded her screw and gear for driving it, openly violated the conclusions deduced from the valuable experiments of the *Dwarf*. Her screw of coarse pitch, and large surface, driven at low velocities, although used with an engine of very superior power to that which formerly drove her paddles—failed to produce in her any increase, if indeed she equalled her former speed; and she stands a severe lesson of the risk of violating principles once fairly deduced, her chief value consisting in her having confirmed the importance of the application

of those principles in screws up to the diameter of 12 feet. An increased multiplying wheel was provided for her, and preparations made for altering her according to present experience in these matters, when it was found that a tug was wanted at Gibraltar, and to fill that honourable post she was sent. It was upon this voyage that the interesting event recorded by Commander Hoseason took place; viz., that the *Phœnix* "stood still and looked at the sea:" a "fact" of which I have no more doubt than I have of the sea's having also stood still to look at her. It must have been a case of mutual surprise; on the one side a queerer craft has perhaps never been sent forth from our dockyards, to float on its surface; on the other, when the *Phœnix* did find herself adrift in the face of a fresh breeze in real blue water, she could not but feel conscious of being out of her element. The number of revolutions made by her engines, when she was in this state of confusion, it appears was registered somewhere else than on earth ("Heaven only knows!") And when the gallant Commander, by correcting the *Fairy* "fact" of the "five knots" shall have "scratched his own name off the list" of "living men," he may perhaps find himself in a *state* better adapted than this, to ascertain what it was.

The *Phœnix*, too, may now "go in peace," and behold the great "fact" of the *Great Britain* appear on the stage, with a number of little "facts" tacked to her. The first of these which I shall notice as having been made subservient to the attack on the screw, is the immense quantity of fuel consumed in this ship as compared with the work done; and this at first promised to afford capital material for a hard hit,—the chief charge against the screw being, that it will always insist on its engine working so quick; and will not allow it to be quieted down even by the soft arts of *expansion*. But as the "fact" gradually came to light, that the engines of the *Great Britain* could seldom, if ever, be induced by any art to work up to near the number of revolutions they were constructed for, some qualms of reason appear at last to have entered the mind of the gallant Commander as to the untenable nature of the indictment filed against the screw under these circumstances; and while as much as possible of the mischief of the charge is allowed to remain and take due effect, a querulous "P.S." to his letter of the 24th of January, is made to contain a sort of half confession, that the great expenditure of fuel with little comparative effect *might* proceed from the defective arrangement of the engines. And as I here first find him on the right scent to arrive at truthful conclusions, instead of disturbing, I shall only "halloo" him on his way, bidding him refer to a letter in No. 1190 of the *Mech. Mag.*, if he desires to know the true state of these engines in times past; and leaving her future logs to tell what use they are now able to make of her propelling—it being remembered always, that the screw now in her, of four threads, is one which past experience forbids us to expect the best results from.

But the *Great Britain*, it seems, is also a great roller—even to a "frightful" and "dangerous" degree; and this "fact," too, we are assured is "marked, clear, and decisive" as one of "the manifold mischiefs attendant" (like evil genii) "upon the screw propeller," and "the inevitable consequence of this mode of propulsion." It might have been supposed that the *modus operandi* of effects so clearly traceable to their source would have been disclosed to us by our talented instructor; but a few lines further on, we find that he abandons the screw as having anything at all to do with it; and the "terrific rolling" of the *Great Britain*, we are told, is the result of a "cause" at once most "*simple*," but most mysterious. It is produced, Mr. Editor, *not* by anything she has; but—will you believe it?—can any poor, mere mortal believe it? no doubt it is propounded to us as an article of faith, rather than as one of reason—of faith on the unquestionable printed word of this great commander,—that the "terriffic rolling" of the *Great Britain* is caused by that which she has not, never has had, nor is ever intended to have, a pair of paddle-wheels. Oh, paddle-wheels most potent, even when non-existent! Oh, cause most remote, nay, most negative! yet producing effects most positive, nay terrific! I am lost in amazement! I dare not disbelieve, and know not which to wonder

at most, the mysterious effect which can be produced by even supposed "paddle-wheels," or the mysterious powers of that mind to whose comprehension the unheard of relations between cause and effect here unfolded to us can appear "*simple.*" And as the whole range of mental science, logic, ethics, metaphysics, appears not even to have contemplated the existence of a cause so wondrous, I can only conclude that I have indeed engaged in controversy with a being of so uncommon a nature here, as must clearly justify me before the world in holding with him the least practicable amount of discussion.

Before closing it, however, I should like to take down this remarkable recipe for a rolling ship, and by a sort of rough analysis, exhibit what I conceive must be its mode of action in the case of the *Great Britain* before us. It will stand thus, I apprehend.—First, remove a dead weight of some fifty tons, in shape of screw, shafts, gearing, &c., and from a position at some feet below the centre of gravity to one at some distance above it, and to this add some hundred tons more in the shape of extra strengthenings, beams, iron knees, &c., these internal applications being intended only to enable the patient to bear the pressure of the external ones, which are to be prepared and used thus: Take of iron and wood (but of the former by far the larger proportion) an open but complicated frame-work, in shape cylindrical, length about thirty-four feet, diameter the same, and weighing, as in *Terrible* and *Retribution*, (say) 140 tons; then divide it into two equal parts across its length, and from a position close to the upper deck, at the extreme breadth of the ship, suspend over either side one, connecting them together by a suitable shaft. Then roll! No, indeed, Mr. Editor—no rolling now; the cure is complete. How? The centre of gravity of the ship has been raised many feet? Nothing whatever to do with it. Every principle of hydrostatics has been violated! Psha! Who ever heard of them? I'll tell you, Mr. Editor, how it's done. Don't you see that the paddles were of equal weight, and suspended at equal distances from the central line of the ship's length? Well, then, "the weather-wheel will take a powerful force to raise it out of the water:" And don't you know how light and buoyant a thing a paddle-wheel composed of some forty tons of iron must be? Well then, "the lee-wheel will take a still greater force to immerse it;" and thus, as soon as ever the ship begins to think of rolling, the paddle-wheels begin to think of bringing into "full operation" these "alternately powerful counteracting effects," on which she very wisely desists from gratifying her "dangerous and mischievous propensity." From all which we conclude; first, that paddle steamers are quite unable to roll at all; and secondly, if sometimes detected in the sin, it is for want of the above remedy, because their paddle-wheels are not half heavy enough, and, like "Oliver Twist," they become uneasy, and "ask for more."

Now, do bear with me, Mr. Editor, one little bit more. The Commander would so like to be told, and as I know all about it, I should so like to tell him, what made the screw of the *Great Britain* give way. The great screw of the *Great Britain* made of real wrought iron, and weighing the enormous weight of 77 cwt., (might it not be made to appear more "enormous" by multiplying by 112?) and compared with which, the appendages and appurtenances of the *Victoria and Albert*, a vessel of just one-third her size, which weighs 84 tons, are of course as lightness itself, mere "*puff.*" Well then, but quite in confidence, it was just this:—From the very first this said screw had in its composition a large spice of self-sufficiency, and rejected alike experience and advice; though warned that it "was undertaking no easy task," it seemed to smile and say that "It had looked well to what it was about," and "felt assured that it was in a position to maintain its ground against all coming" weather; and so, when the ship was ready, it stepped forward and commenced a task which its best friends well knew, and told it, that it possessed neither sufficient material, nor any other requisite qualification to perform. However, it started, and for some time things went on smoothly; it went and it came, and the screw was gratified by seeing itself put into print—once, twice, thrice,—and it began to think its victory won; that it was surely to be the appointed instrument for directing the steam energies of "Great Britain;" and it flattered itself, and behaved proudly, and

cried "cock-a-doodle-doo" more than once. But at length the day of trial that was to expose its weakness arrived; arm after arm, that it had so boastfully relied on, was seen to fall away under a pressure it was never calculated to withstand, and little expected to meet with; and though it held out to the last, and zealously did its best, yet "it found the place too much for it." It signally failed, broke down entirely, and it returned to its friends a cripple,—a mere stump,—to excite the ridicule rather than pity of all who had noticed its pretensions.

Mr. Editor,—I am now really quite tired, and doubtless yourself and readers are so too; and I know not that I can more appropriately end all further controversial notice of the gallant Commander's letters than with this pretty little moral, "*tail* of a screw;" and I shall do so the less unwillingly that I conceive I may have already said enough to show that the screw must be admitted into the list of those instruments with sharp edges, the rough handling of which by those who are practically acquainted neither with their use nor their powers, is always held to be dangerous.

In closing this controversy, also, the tone of banter in which I have conducted it, and by which I thought I could best neutralize the mischief which I fear was most intended by the "letters," ceases too; and while permitting myself to indulge its humour, I trust I shall not be considered as having past those limits which the unsparing nature of the attack made on a principle so important, and the peculiar tone of challenge to the discussion of its merits, which was adopted by my opponent, fairly warranted.

I beg to assure him that I am not the Don Quixote whom he seems so anxious to find out for a foe; and that I trust it is far more in consonance with my own character and disposition to desire to accept the hand of a brother officer rather than to meet his "steel." I also cheerfully acknowledge that his exertions are entitled to sincere thanks, and can rejoice that they met with reward. I believe, too, that in the attack on the screw propeller which he has thought well to make, he has himself been a victim both to bad advice, and worse information, and in taking of him a farewell, and bidding him "go on and prosper," I beg again to offer him the freest use, for transcript or examination, of all the diagrams and data which for these three years past I have studiously collected on this subject.

To you, Mr. Editor, and to those who may deem that subject one of sufficient importance, I shall endeavour to redeem the pledge here made, of exhibiting seriatim in future letters, the grounds on which the advocates of the screw confidently expect the ultimate realization of every advantage they have put forth as desirable from its adoption.

E. P. HALSTED.

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THE SCREW-PROPELLING CONTROVERSY.—A FEW WORDS BY A "LOOKER-ON."

Sir,—I do not flatter myself that I shall be considered a "foeman worthy of the steel" of your gallant correspondent, Commander Hoseason; but this I do know—that the military position he has taken up; namely, that the accident which befel the *Fairy* steamboat is "conclusive" of the whole controversy, is not tenable, but is, on the contrary, one which, when properly considered, proves, beyond the possibility of doubt, the superiority of the screw over paddle-wheels. I am really astonished that a writer who, apparently, has taken so much pains to make himself perfectly acquainted with the subject of steamboat propelling, should overlook, or at least decline to take notice of, the peculiarity in screw-propelling so prominently exhibited by the circumstance he alludes to in the *Fairy;* for it has at various times, under other circumstances, been brought into notice in the pages of your very useful work. The great blunder committed by your correspondent is, that he does not compare the slip of the screw with the slip of the paddle-wheel, or the slip of the screw at high and low velocities with that of paddle-wheels under the like velocities. The *Fairy*, when the power of her engine was reduced one-half, performed five miles an hour; but when the power was doubled, her speed was increased *more* than double, or thirteen miles an hour. Could such a thing occur with paddle-wheels? We know by experience that it could not. But half-power may make paddle-wheels to accomplish ten miles an hour, and by doubling the power, you may increase the speed to twelve or thirteen miles; but why can you not to twenty? It is mani-

festly the slip of the wheels alone that prevents the speed increasing in the same ratio with the power. The simple question then is—What was the slip of the screw on each of these occasions, and what would have been the slip of paddle-wheels? It is perfectly clear, that while the slip of the screw continues nearly constant, or rather diminishes as the speed of the boat increases up to some certain point, that of the paddle-wheels would increase faster than the velocity. It is, therefore, too bad to be throwing blame on the quarter not deserving of it. The fact is, the screw does its work well, but the steam-engine *does not;* and your correspondent, "An Observer," very properly asks—Why may not a vessel fail from faults in her engines, quite independently of both paddles and screws? When the attention of scientific men is not directed to the proper quarter to correct imperfections, little good can be expected to result. Much has been said about the performances of the *Great Britain.* Why! the slip of the screw in all the experiments made with her, was much less than it would have been with paddle-wheels. The blame properly attributable to the engines should not be bestowed on the screw. I am perfectly satisfied that two paddle-wheel steam-boats, of 250 horses power each, would draw the *Great Britain* with the same speed as her 1000 horses power with the screw; but would the slip of the paddle-wheels, although presenting so large a surface to the water, be less than the screw? Certainly not. Indeed, I am surprised such an experiment has not been tried before now; for this only is the proper mode of investigating the question. In the description of experiments on which your gallant correspondent places so much reliance, the screw is required to do the work of a tug-boat. The Indian prow will sail with the wind on the beam faster than any boat that ever was built, with a direct wind; but it would not answer for a tug-boat. It would run away from any sailing-boat that was ever invented, but it would scorn to tow a boat. At page 270 in the October Number of your work, the tractive power of a paddle-wheel is stated to be 627 lbs., and that of the screw 583 lbs.; but when the boat was in motion, the paddle-wheels working against the screw, the tractive power of the latter was reduced to 317 lbs. Now this experiment pointed out the proper course to be followed to test the two modes of propulsion. Why was not the tractive power of the screw ascertained when the screw alone was working at the highest speed, and then compared with the tractive power of the paddle-wheels, when working alone also at the highest speed? No doubt the latter would be found considerably deficient in that respect.

I am, &c.,

A LOOKER-ON.

### SCREW-PROPELLING.

Sir,—I am pleased to observe that the letters of Mr. Hoseason, upon screw-propelling, have at last attracted the attention of a member of his own profession. I consider Captain Halsted's strictures to be as just as they are well merited.

As in Mr. Hoseason's former lucubrations, (the errors and misjudgments in which I had recently occasion to expose,) so is there in the present, a very minute portion of truth, but so overlaid with prejudice, and error, and much that is personal, that it becomes absolutely valueless.

Though I am by no means sanguine as to the full success of the screw, and believe it to be inferior to the paddle-wheel, *as a propeller*, in the ratio of 8 or 9 to 12, taking an average of all the circumstances in which either may be placed; still, no reasonable man can deny that, for special purposes—those, for instance, referred to by Captain Halsted—its advantages far outweigh the defect in its propulsive powers.

The great problem now to be solved is purely mechanical, namely, to invent and construct the means by which it may best be driven, with the least loss of power by friction, and without frequent derangement from the enormous thrust of the screw. I should recommend Mr. Hoseason to study this part of his subject, as being far more likely to be useful and creditable to him than the course he has taken.

In Number 1168, page 444, will be found a letter of Mr. Hoseason's, to which I refer your readers, wherein he brought a heavy, and, I believe, a grossly unfounded charge, against a most respected member of my profession, which he has not yet substantiated or retracted, although called upon to do so. I now beg to tell him, that until he does either the one or the other, he must ascribe the

silence with which his more recent lucubrations have been regarded by civilian engineers to other causes (not difficult to guess) than to either a conviction of their truth or inability to answer them.

I am, Sir, &c.,

PRESSURE NOT PUFF.

London, June 10, 1846.

P.S. I have been absent from home, and have not been a regular reader of this journal for some weeks past. May I therefore beg Mr. Farey to send the documents he has alluded to, relative to Mr. Watt's discovery of the expansion of steam, to you for publication: they must be interesting, and will, doubtless, clear up the point for ever. I shall be happy to assist with some drawings of the early engines of Mr. Watt, as requested by S. S., to whom I beg to apologize for the delay. P. N. P.

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THE LATE MR. RADLEY'S EXPERIMENTS IN PADDLE-WHEEL AND SCREW PROPELLING ON CANALS.

Sir,—It will be in the knowledge of some of your readers that the canal which connects Manchester with Huddersfield, traverses a district intercepted by a chain of hills, under which the continuity of the canal is preserved by a tunnel 3¼ miles in length, beginning at the head of the Valley of Saddleworth, and terminating on the opposite side of the ridge, near Marsden.

The great loss of time occasioned by the transit of boats through this tunnel has always been a serious drawback upon the utility of the canal, and was found in its early commercial application so fruitful a source of loss of traffic, that the committee of management offered, about 1815, a reward for the best method of reducing the time of passage of a boat through the tunnel from 3¼ hours to 1 hour; and, accordingly, a number of methods were proposed, experiments made, and models of tug-boats exhibited, all of which ultimately failed to answer expectation. Stimulated by the desire to invent usefully, my late father constructed two boats, of the same size and shape, the one propelled by a screw, the other by a paddle-wheel,—both variously modified, as fancy or induction might suggest.

In the course of these experiments he deduced the positive facts—That a continuously flat-bladed screw would not propel so efficiently as one whose continuity was broken; and that no form of screw was near so efficient when working in free water, as when revolving within a containing tube, more or less continuous.

None of these forms of propeller were exhibited, in consequence of their decided inferiority to a particular modification of the common paddle-wheel, whose value seemed to be so great as to induce him to keep it secret until he could test its utility and absolute superiority by large experiments and more extensive modifications. I have the results of his experiments which proved the great superiority of the paddle-board over the screw-blade as a medium of propulsion, and more especially in that particular instance before alluded to, where the entire paddle-wheel could be submerged with increased effect, but in a manner totally different from, and more simple than "Hunter's submerged wheel," noticed at page 376 of Vol. xliv. of the *Mech. Mag.* If the object of your journal be to develope what is new, as well as to evoke from a state of neglect and oblivion that which is useful,—and even by bringing capitalist and inventor together for public good, render that which lies in abeyance of service to mankind, and, it be at the same time within the scope of your intention to permit your pages to become the vehicle for promoting the interests of inventors,—then I would solicit your condescension to enable me to find some one amongst your numerous readers able and willing to assist the writer to patent and promulgate this very valuable form of the paddle-wheel. I shall be happy to entertain the application of any honourable and pecuniary responsible correspondent, and to afford every reasonable explanation. To a mind conversant with the subject, and with the requirements of aqueous propulsion, this invention possesses merits so apparent and insistent as to command assent without previous trial.

Whilst I am upon the subject, I may incidentally mention, that one of the methods of propulsion offered to the notice of the canal company, was an invention of Mr. Rastrick, their engineer, and the precise prototype of that system of railway traction lately exhibited by Mr. Parking, at 11, Basing-lane, London, and vaunted in the public journals as the very

acme of perfection of railway transit, but which will assuredly prove a complete failure, for the very reason that its exemplar did thirty years ago.

I am, yours respectfully,
WM. RADLEY,
Chemical Engineer.

70, Great Russell-street, Bloomsbury,
June 10th, 1846.

## THE GREAT BRITAIN STEAMER, "AS SHE WAS AND IS."

Sir,—I have read with much astonishment an article in your Magazine, styled the "*Great Britain* as she was and is." Knowing how anxious you are to place before your readers correct *facts*, I am sure you will readily insert the few observations I have to make upon the statements contained in that article.

When last I had the pleasure of speaking to you upon this subject, you remarked, with great justice, that "there was a shameful perversion of *truth* somewhere," and that "if these alterations and improvements had really been effected, it was impossible for many of the former statements to have been true." For my part I cannot help thinking that your informant, in giving the diagram of the indicator from which he computes the original power of the *Great Britain* to be but 686·4 horses power, has laboured under this error—that he has taken it at a time when the engine must from some cause or other have been sadly out of order. It is, I think demonstrable that the horse-power of the *Great Britain* on all her trips round England, as well as when crossing the Atlantic, must have been much higher than this. I can perfectly understand how advantageous it would be to the Company if it could clearly be established that such beneficial alterations had really been effected, for instead of the fault lying with the screw, the cause of her inferior performances would be found in the inferiority of her steam-power. Apart from the many disgusting puffs as to the beautiful working of the engines, their *great* power, and the high velocity at which the vessel was driven through the water, and which were published in every daily journal of the kingdom, I have the authority of Capt. H. Austin, for the assertion, that previous to the first voyage of the *Great Britain* across the Atlantic, a government engineer, holding a position which enabled him to know the truth, stated that the *Great Britain* would "*go the pace*," for he had seen the indicator diagrams of that vessel's engines, and that they worked up to *fifteen hundred horses power!!* Now, sir, Capt. Austin repeated that to me *twice*; once when dining at his table, just as the *Great Britain* was on the eve of starting across the Atlantic. My reply was, that we should see what she would do with that immense power in the Atlantic. Remember, sir, my published statement of her performances was taken from the columns of the *Times*, from a lengthy article written in her favour, and which evidently came from the office of the Company. I clearly proved, by comparing her performances with Cunard's paddle-boats, what miserable work she had made of it, and that too during one of the finest months in the year. When the *Great Britain* went on her trial trip round England, in the month of June, 1845, just previous to her departure for America, many of my friends took that trial trip in her. One, a captain in the navy, who knew I was not favourable to the screw, wrote to inform me that she had steamed fairly in a dead calm, twelve knots per hour. Now, will any engineer in the kingdom state that she would have done that if her steam-engines had been but 686 horses power? If she accomplished twelve knots an hour with a power (as alleged) of only 686 horses power, what might we expect the 1665 horses power to produce? If we assume the horses power required to be as the *cubes of her speed*, we must come to the conclusion that the last named horses power would have given *fifteen knots per hour!* So, instead of the *Great Britain* being an inferior boat, she is, by this showing, the most wonderful vessel ever launched upon the water for transatlantic navigation.

Again, from the log of the *Great Britain* published by the owners of the vessel, and inserted in the columns of the *Times*, I deduced the fact that her mean average velocity on the *homeward* voyage was but $8\frac{4}{10}$ knots. Now, comparing that with a mean taken of the performances of *all* Cunard's boats on the *homeward* run, but deduced from *both* winter and summer voyages, inclusive and over a period of *two* years. I proved the

speed of the *Great Britain* to be inferior to that of these paddle-boats by $\frac{8}{10}$ of a knot per hour! To understand the full force of this comparison it is proper to observe that the mean average velocity of the Cunard boats is deduced from voyages that show, in the worst passages in winter as compared with the summer, a difference of cent. per cent.; the shortest voyage being about ten days, the longest twenty. Nevertheless, satisfied with the immense inferiority of the *Great Britain*, I was content to state the comparison as I did, though strictly speaking it ought not to have been made at all, tending apparently as it does to the credit of those beautiful paddle-wheel boats.

We have now, however, the credit of the house of Maudslay and Field fairly embarked in the support of the *Great Britain*. We are told, on their authority, that the power of the vessel as proved by the Indicator is now 1663 horses power. We shall shortly have published the result of these wonderful alterations; and if the Company dare to run her through the winter, I will strike the mean of her performances.

I beg to give an extract from the note-book of a Captain of the army, who has been much at sea, and who went on the trial trip of the *Great Britain* as before stated, and you will perceive it authenticates the statement of my friend the Captain of the navy. I am ready and willing to give you the names of both parties, and I question not but that my friend will let you see his note-book if required.

"*Great Britain Steam-vessel, June 13th*, 1845.—Day hot and foggy; passed Folkstone at half-past 7, P.M.; going exactly 12 knots per hour; sea quite calm."

Now, Sir, as the Great Western Company have reported to the Admiralty the result of those wonderful improvements, and as they have stated her velocity to be *less* even than the above performance—for in their report they have given it in as something *under* twelve knots in smooth water and a dead calm—we arrive at the curious *fact (?)* that the horse power of the *Great Britain* has been (if we are to believe your indicator diagrams) increased *nine hundred and seventy-six horses power*—without producing any effect!

*Magna est ventas et prevalebit.*

I am, Sir, &c.

J. C. HOSEASON,
Commander R.N.

Army and Navy Club House,
8th June, 1846.

## TAYLOR'S ATMOSPHERIC RAILWAY VALVE.

[Registered under the Act for the Protection of Articles of Utility. Mr. James Taylor, of Long-lane Bermondsey, Inventor and Proprietor.]

Fig. 1.

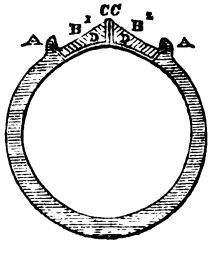



Fig. 2.

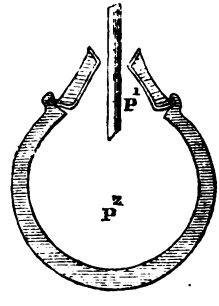
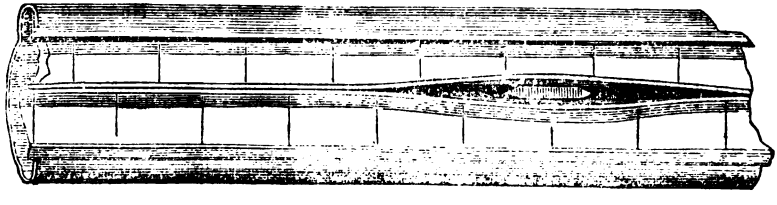



Fig. 3.



In the present halting state of the atmospheric railway system, where the inefficiency of the longitudinal valve appears to be the main thing which stands in the way of complete success, every suggestion for its improvement is well deserving of attention. Mr. Taylor, it will be seen, proposes to dispense altogether with the use of a sealing composition; and of all the valves which have been constructed on that theory, his is certainly one of the simplest. The closing of the tube by this means could only be approximative, but perhaps it would be sufficiently so for practical purposes. Trial only can decide, and that we hope it will receive.

Fig. 1 is a cross section of the valve as it appears when closed; fig. 2 is a view of it in a position which it assumes as the piston is passing through; and fig. 3 a top plan.

AA are the flanges which form the hinges of the valve; they are raised on the top of the atmospheric tube, along the sides of the longitudinal slit or opening, and are of the peculiar recurved form shown. The valve is made in two pieces, or halves, $B^1$ $B^2$, which meet exactly over the middle of the longitudinal slit. Each piece consists; *first* of a continuous strip of leather, or other flexible material, which is folded back at one side, so that it may fit on that side with considerable exactness into the hollow formed by the recurving of the flange, and turned up straight on the other side at nearly a right angle to the valve seat; and *second*, of a series of flanges of metal, (or other suitable substance,) DD, which are laid upon the leather, C, and serve to keep it in its place, and of the form assigned to it. These flaps are inserted within the back fold, at one side of the leather, so as to turn therein as on a hinge, and thus rise and fall freely, while by the preponderance of weight on the opposite side, they help to close the valve after the passage of the coulter and piston ($P^1$ $P^2$.) And, farther, the two sets of flaps are so placed in respect of each other, that those of the one set shall break joint with those of the opposite side, and thus contribute as well to the support of the half of the valve opposite to them, as of that to which they are immediately attached.

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## OBSERVATIONS ON M. MITSCHERLICH'S ESSAY "SUR LES REACTIONS CHIMIQUES PRODUITES PAR LES CORPS QUI N'INTERVIENNENT QUE PAR LEUR CONTACT." [ANN. DE CHIMIE ET DE PHYSIQUES, 1843.]—BY HOR. PRATER, M.D., PH. D.

Although the above paper of M. Mitscherlich was written in Dec. 1841,—that in the *Ann. de Chimie* being only a translation from the German—it contains many remarks that are pregnant with interest even in reference to the action of platinum on a mixture of oxygen and hydrogen, though written previous to the discovery of the gaseous pile by Professor Grove.

M. Mitscherlich in the present article endeavours to establish that what Berzelius has called the catalytic force, ("with as much reason," says he "as we say force of affinity," p. 34,) is an attraction of the *surface* of matter; and he endeavours, by observations on charcoal, wood, "noir de platine," &c. &c., to establish it as a fact, that attraction is in proportion to surface. It is, however, obvious that this attraction does not depend on surface merely *as surface*, otherwise *all* kinds of powders, and *all* surfaces, would exhibit this attraction, which is not the case. We come to the conclusion, therefore, that this attraction is as obviously *elective* as common chemical attraction; and that it is analogous to such attraction, being also in the same substance in proportion to *surface*, just as common chemical attraction is proportionate within certain limits to *mass*. Nevertheless, it is not common chemical attraction, but a distinct power, and probably in *all* cases dependent on electricity; since Professor Grove, by the discovery of the gaseous pile, has proved it to be so in the case of platinum, oxygen, and hydrogen. But although it is probably in all cases only *electrical attraction*, yet we are not authorized at present to assert such with certainty to be the case. Such attraction of surface may possibly be in many cases totally distinct from electrical attraction. In a few of the cases mentioned by Mitscherlich it is probably a *mechanical* attraction; for even when it appears so, as in the case of precipitates retaining a portion of the salt of the solution from which they are precipitated, we find something like *elective* attraction. Thus Mitscherlich finds that when solutions of nitrate of soda, barytes, and sulphate of soda are

mixed, the sulphate of barytes retains 2 per cent. of the nitrate of soda which cannot be washed out by water; whereas the same precipitate shows no attraction of the kind for muriate of soda, when muriate of barytes is used intead of the nitrate. (p. 21.)

With such facts before him, it seems rather singular that Mitscherlich has not decidedly distinguished this attraction of surface from a purely mechanical attraction; yet he does not seem to have done so in his paper, or I am in error. At one place, indeed, he says, (p. 19,) "But porous bodies do not act by their surface only; for if it were so; the absorption of different gases by different substances ought to be in the same proportion. It is not so, since, according to Saussure, wood condenses more carbonic acid than charcoal, and asbestos, '*l'ecume de mer*,' tissues of cotton and silk, absorb different gases in other proportions than box-wood charcoal." I presume by this he means to say they act either *mechanically*, (by preventing the escape of the gas after it has once been absorbed,) or *electively*, as well as by attraction of surface. Probably the former is his meaning; and if so, I do not know any passage in his paper where he considers the attraction of surface elective. This conjecture is confirmed, by observing that he makes the above paragraph apply only to "porous bodies."

Mitscherlich has included some cases of attraction of surface, which seem *sui generis*, or at all events not depending apparently on electricity. "Thus," says he, "if you cover a piece of glass with a moist piece of bladder, and after it is dry seek to detach it, you take away pieces of glass with it. The attraction then exercised on the glass by the bladder is stronger than the cohesion of the molecules of the glass itself," (p. 21.) But although not electrical even, the attraction of surface is *elective*; for otherwise bladder would adhere equally to all sorts of surfaces equally smooth, (metallic or otherwise,) yet it probably will not.*

Again; probably, there is less of anything like elective attraction in the following case mentioned by the German chemist than in any of the others, though experiments with different substances are wanting before we can pronounce a satisfactory opinion on the subject. "A dissolved body deposes itself on threads, or any solid bodies suspended in the solution, much more quickly than if they were not there," (p. 22.)

In this case, however, as in all the others adduced by Mitscherlich, we, as he says, see an *attraction of the surface*, and the merit of this generalization belongs to him. All that seems further wanted on this subject is, to distinguish, by accurate and numerous experiments, those cases in which such attraction is elective from those in which it is not. The probability seems that it is elective in all cases, for, besides being so in all the cases mentioned above (except perhaps the last) it is so in the case of copper and iron turnings at incandescence decomposing ammonia, because neither turnings of platinum, nor fragments of glass have this power, except in a *very small degree*, says Mitscherlich, (p. 25.) The *extent* of surface exposed in this case has little or nothing to do with the decomposition, or glass or platinum would act equally well; the attraction must be *elective*.

M. Mitscherlich applies his principle of the attraction of surface to fermentation. The decomposition of the sugar into alcohol and carbonic acid is only, says he, effected by the surface of the globules of ferment; for if we put a small quantity of ferment into a tube closed by blotting paper (*papier Joseph*) at one of its extremities, and introduce this into a solution of sugar, this will pass through the pores of the paper, and undergo fermentation in the tube, but not in the solution, until a long while afterwards, and only when some of the ferment has so softened the paper as to be able to pass through. But that the attraction of surface in this case is *elective* also, is shown by the fact stated by Mitscherlich, that the sole way of effecting this decomposition of sugar is by "an organised body" —"globules of ferment." "These globules (says he) undergo no change during fermentation;* but when you destroy

* If it does, then of course the attraction is not elective. The attraction, however, here is probably ess from mechanical causes than in the absorption f gases by wood or charcoal.

* Caignard de la Tour considered the increase in *number* during fermentation, and probably this is Mitscherlich's opinion; but he says they do not increase in *size*; his opinions on this subject are the more important, as he is a microscopical observer himself.

them, they produce it no longer. In putting them in contact with bodies that destroy fermentation, you may by the microscope see them contract at the instant such bodies touch them." (p. 31.)*

Mitscherlich concludes that the globules of ferment in contact with a solution of sugar, comport themselves exactly like sponge of platinum in contact with oxygenated water.

With regard to the origin of these globules, he says, as Scultze and Schwann have found, that if air be not present, or air only which has previously passed through red hot tubes, they are not formed; the balance of arguments is against equivocal generation, if we could be sure that they do not arise in the liquid from points too minute for observation.

In reference to the coagulation of milk by rennet, he says, that he was able to coagulate milk by an infusion of the membrane that covers the cæcum of the calf, and that it is consequently erroneous to suppose that the inner membrane of the stomach alone has that power. He adds, "*La membrane et son infers, ils ne possedent pas de la reaction acide, et le lait resti neutre pendant sa coagulation.*" (p. 33.) This, we may observe, has been found by previous experiments, &c., and consequently is a sufficient refutation of Liebig's assertion that such coagulation takes place in consequence of acidity. M. Mitscherlich consequently, we may infer, classes the coagulation of milk by rennet among other, so to speak, catalytic phenomena. Indeed, the great merit of his paper is, that by his great chemical knowledge, and profound penetration, he has been able to perceive this action where it had not hitherto been suspected. Thus, for instance, in reference to sulphurous acid gas and oxygen: These do not unite, says he, if left alone, but do so if in contact with platinum sponge, *or* when the oxygen is combined, as in nitrous acid gas. In this case, sulphurous acid unites with oxygen, the nitrous oxide gas contained in the nitrous acid gas probably acting like spongy platinum; or at all events, as nitrous oxide gas combines with oxygen as soon as presented to it, and sulphurous acid does not, we see, that one substance may have a stronger affinity for another, and yet not be able to combine with it.

As I have shown in this memoir that the attraction of surface must be *elective*, I was inclined at one time to conceive, that it was merely a *weaker form* of common chemical attraction, but I abandoned that opinion from considering that copper filings, heated in a tube through which ammonia is passed, decompose the ammonia. Now as this is a *chemical combination*, the attraction of surface in the copper, must be stronger than common chemical attraction. The same reasoning also applies to charcoal-powder decomposing certain saline solutions, which are also chemical combinations. We must be content, therefore, at present with considering it a distinct, and often stronger power than common chemical attraction, but resembling it in being elective.

* M. Bouchardat (Comptes Rendus, Sep. 23, 1844) confirms the opinion of the life of the globules of ferment, by showing that fermentation is stopped by the same agents that destroy the vitality in plants or animals. I adopted this view in my remarks on Liebig in the *Lancet*, some years ago; and Mitscherlich also considers the same opinion established. He says "the globules begin to form in the *fermentible* juices of plants, *before* the fermentation begins," (p. 31.)

## FIELD'S UNIVERSAL SAFETY HORSE-SHOE.

[Registered under the Act for Protection of Articles of Utility. Mr. William Field, of Oxford-street, Veterinary Surgeon, Inventor and Proprietor.]

Fig. 1.

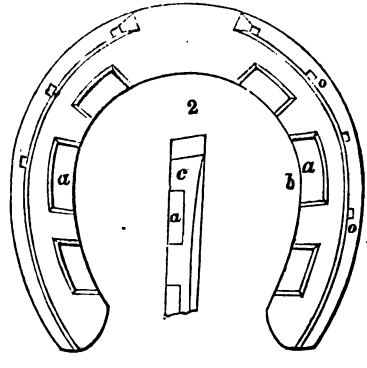


Fig. 1 is a top plan of this horse-shoe, and fig. 2 a section. The nail-holes, *o o*, are arranged round the circumference of the shoe, as usual, and the iron on the upper face, hollowed out in a gentle slope towards the interior edge of the shoe, to accommodate the sole of the horse's feet. On the under surface

there are six notches or recesses, *a a*, of a rectangular form, which are cut down through half the thickness of the metal, but deepened off towards the outer edge, *b*, so that the bottom of each notch shall present a surface inclining inwards. The angular edges of these notches will catch against the projecting corners and other points of pavements, whether they consist of granite, wood, or of Macadamized stones, and thus afford a sure footing to the horse while any sand, clay, or other matter which may lodge in the notches will have a tendency to slide out of them, in consequence of the inclined direction given to the notches at bottom, especially when acted upon by the beat of the horse's foot. The strength and durability of the shoe are secured by the portions C C, which are left of the entire thickness, as shown in the section, fig. 3. In the drawings the notches *a a* are represented as six in number, but either a greater or less number may be used, as may be judged expedient.

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The preceding invention has been the subject of some recent proceedings in the Court of Chancery. On the 27th of April an injunction *ex parte* was obtained against Mr. Field, on the allegation of his shoe being a piracy of one patented by Mr. D. Woodin, 27th March, 1845. On the 4th of June the injunction was, on the application of Mr. Field, and after a full hearing of counsel on both sides, *dissolved with costs.*

In Woodin's specification, he states that his invention has for its object the forming of the *upper* surfaces of shoes for horses and other animals, in such manner as to give greater holding by affixing a peculiar structure of roughing. He then explains that the roughing consists in making a series of projections (*b c c e* and *f*) on the *upper* surface, "so that the foot of a horse or other animal having such a shoe fixed thereto would be supported by the (said) series of surfaces (*b c c e f.*") He afterwards states, that "the number of projections, (*c*,) as well as their shape, may be varied, without departing from my invention, the object of which is to obtain a sufficient extent of surface for supporting the horse's foot when on the ground, by the use of a series of projections, (*c*,) in combination with a projection, (*b*,) toe-piece, (*e*,) and hinder projections, (*f*.)" And he concludes with defining the extent of his claims to be as follows:—"The shoes, according to my invention, may be made by casting them of malleable cast-iron, in moulds made according to the pattern desired, in a similar manner to the casting of other constructions of horse-shoes; or they may be made by forging, or by dies, or bars of iron for the shoes may be rolled. And I wish it to be understood that I claim neither of these processes of making shoes, when not applied to making shoes according to my invention as herein described. But what I claim is, *the mode of making shoes for horses or other animals as herein described.*"

[It is obvious that Mr. Woodin throughout his specification, which is excessively ill-drawn, uses by mistake the term *upper* for *under*. The *upper* surface of a horse is that next the horse's foot; the *under* is that which comes upon the ground; and it is to the under that Woodin's "projections" are affixed.]

The case put by Woodin's counsel was, that the "angular edges of the notches" in Mr. Field's shoe effect precisely the same object as the projections in Mr. Woodin's shoe, and constitute therefore a substantial infringement of Mr. Woodin's patent. The answer made to this was; 1st. That Woodin's projections serve as the constant and only support to the horse's foot; while Field's "angular edges" only come occasionally into play when they strike against an inequality in the ground; 2ndly. That Woodin's "projections" are additions affixed to the usual shoe, and protruding beyond the general surface of the shoe, so that they have the injurious effect of constantly digging holes in the ground travelled over; while in Field's shoe there is no projection whatever beyond the general under surface of the shoe, and no such digging effect is produced; 3rdly. That the notches or recesses in Field's shoe have for their object to catch hold of any inequalities in the ground, and so assist the action of the horse; while Woodin's projections must necessarily come into rough collision with those inequalities, and have the effect rather of lessening than increasing the sure-footing of the animal; 4thly. That the inclining of the recesses in Field's shoe towards the outer edges, causes any matter which they may take up to slide out immediately afterwards; and 5thly. That Woodin's invention involves a considerable increase in the weight and expense of the shoe; while all the advantages of Field's are secured with less weight, and no addition to the cost.

It was shown in the course of the proceedings, that the roughing of shoes by raising projections on them in the manner proposed by Woodin, is a very old affair. A book was produced, entitled "*The Foure Cheapest Offices belonging to Horsemanship;* by Master Blundeville. Imprinted

by Humphrey Lownes, for the Company of Stationers, 1609," which completely destroyed the plaintiff's pretensions to novelty. "There is nothing," said the Vice-Chancellor, "in the principle of the plaintiff's invention which differed essentially from the description in Master Blundeville's book, where the very thing was produced which was the object of this patent."

The following is the passage in Blundeville referred to:—

"Of shoes with swelling weltes or borders about." (Chap. 29.) "In Germaine, High Almaine, the smithes doe make their shoes with a swelling welt round about the shooe, which being as high as the heades of the nailes, or rather higher, doe save the nayles from wearing, which kinde of shoe for lasting I must needes prayse. For I myself have travelled, my horse being shod with those shoes, in those countries, above 500 miles right out, upon very stony ground, yea, and upon the mountains, without removing shooe or driving nailes. For the shooe being made of well-tempered stuffe, weareth equally in all parts, and the horse also treadeth evenlie upon them, especially his feet being before well pared. Cæsar Fiasclii praiseth also this shooe very much to be used when a horse should runne for a wager, to keep him from sliding. But then he would have the welt to be indented, having sharpe-pointed teeth, like a saw, and that the sponges be as thick as the welt, and that the welt be of a tough, hard temper, for fear of wearing over fast; and if you list to hollow the said shooe in the midst, yet let not the embossed side rise so high as the welt, but lie somewhat lower. With these kind of shooes they use in Italy to shooe such Barbarie horses, gennets, and Turks as are appointed to run for the best game at some publique triumph, or for any other private wager; and therefore sith this kind of shooes is so good to keep horses from sliding, Cæsar Fiasclii thinketh it best to be used to that end, utterly disallowing both combking, frost-nailes, crests, spurs, and all such like devises as are often used by the ignorant sort to keepe their horses from sliding, not considering the great discommodity and hurt that may redound thereof to the horse, by means that he cannot tread even upon the ground: or in the stead of this shooe, they may use the Turkey shooe, or button nails before mentioned, and that shall keepe their horses from sliding better than any of the other devises, and with less harm to the horse."

### THE PERSPECTIVE OF A COLONNADE.

Sir,—I have looked through all the works on perspective that have come in my way, to try to find some rule by which to test the accuracy of the pairs of principal diameters of the ellipses which represent the bases of a row of columns. I have looked in vain; and as a last resource I apply to you, Sir, who have never been backward to resolve the difficulties which embarrass the architectural student.

A PRACTICAL DRAUGHTSMAN.

May 30.

[This question has not, that we are aware, been discussed in more than one place, and that probably inaccessible to our correspondent. It is one of great difficulty, and has not been satisfactorily resolved. We may hereafter give a note on the subject: but we would invite the suggestions of such of our readers as may have looked with any care into the problem.—ED. M. M.]

### NOTES AND NOTICES.

*Brilliant Whitewash.*—As the season has arrived when every consideration of cleanliness and health prompts to the use of lime upon buildings, fences, &c. &c, we give the following recipe for preparing the celebrated stucco whitewash, used on the east-end of the President's house at Washington; colouring may be so added as to give any desirable tinge to the preparation:—"Take half a bushel of nice unslacked lime, slack it with boiling water, covering it during the process to keep in the steam. Strain the liquor through a fine sieve or strainer, and add to it a peck of clean salt, previously dissolved in warm water; three pounds of ground rice, ground to a thin paste, and stirred and boiled hot; half a pound of powdered Spanish whitening, and a pound of clean glue, which has been previously dissolved by first soaking it well, and then hanging it over a slow fire, in a small kettle, within a large one filled with water. Add five gallons of hot water to the whole mixture; stir it well, and let it stand a few days covered from dirt. It should be put on quite hot; for this purpose it can be kept in a kettle on a portable furnace. It is said, that about one pint of this mixture will cover a square yard upon the outside of a house, if properly applied. Brushes, more or less small, may be used, according to the neatness of the job required. It retains its brilliancy for many years. There is nothing of the kind that will compare with it, either for inside or outside walls."—*New York Sun.*

*Telegraphic Communication between France and England.*—It was stated some time ago, that a submarine telegraph was to be laid down across the English Channel, by which an instantaneous communication could be made from coast to coast. The Lords Commissioners of the Admiralty, with a view of testing the practicability of this undertaking, have been pleased to approve of the projector's laying down a sub-marine telegraph across the harbour of Portsmouth from the house of the Admiral, in the dockyard, to the railway terminus at Gosport. By these means there will be a direct communication from London to the official residence of the Port-Admiral, at Portsmouth, whereas at present the telegraph does not extend beyond the terminus at Gosport, the crossing of the harbour having been hitherto deemed an insurmountable obstacle. This want of continuity in the means of

conveying official orders to the dockyard has been attended with so much inconvenience, that Her Majesty's Government had previously given orders for continuing the line of the electric telegraph from the Gosport terminus, by carrying it round the harbour, a distance of six or seven miles. The disadvantage of this arrangement is at once obvious, as there is no railway, or railway police, to protect the lines from accidental or malicious injury, after they leave the terminus. The submarine telegraph is to be laid down in the course of the ensuing week; and if the working of the plan is found to be successful, this mode of telegraphic communication will be adopted in preference to the more exposed one. The telegraph will be conveyed from the terminus of the water-side underground, and, after crossing the harbour, will again be conveyed in a similar manner to the Admiralty-house, it being a subterranean as well as a sub-marine telegraph. In a few days after the experiment has been successfully tested at Portsmouth, the submarine telegraph will be laid down across the Straits of Dover, under the sanction of both the English and French governments.—*Times*.—Captain W. H. Taylor is the projector of the submarine telegraph referred to.

*Sea Sickness*.—A safe and good remedy for sea sickness, which has been tried with the most surprising effect, and which can be used without inconvenience or danger, is a preparation called creosote, the same which is advertised as a remedy for toothache. It may be regarded as infallible; for if it does not always prevent sea sickness, it never fails to prevent the suffering which that malady usually occasions, and the straining of the nerves and muscles which is sometimes productive of very serious consequences. In nine case out of ten, unless the sea be very rough, the sickness will be prevented; but if it does take place there will be a relief of the stomach without straining, and the traveller, instead of lying prostrate during the whole of the voyage in a state of suffering which is indescribable, will be able after the stomach is emptied, to keep his legs, and even to enjoy the motion of the sea. Creosote may be had of any respectable druggist, and is to be thus taken: about half an hour before the passenger embarks, he is to take three drops in a small quantity of water, when on board, if he feels a little nausea let him pour two or three drops on a bit of sugar, which he will swallow, and this he may repeat every hour if he have nausea, or if sickness come on after the stomach has been relieved. Creosote is at the same time a tonic and sedative, and independently of its value as a remedy at sea, assists digestion by tranquilising the nerves of the stomach.

*Ride a hobby*.—This short and familiar advice is easily remembered, and, for its simplicity and its homeliness, we prefer it to any other of a similar meaning more classically or elegantly expressed. A man with a hobby is always active, and activity is a copious source of healthy enjoyment. Moreover he is always learning, for his hobby keeps his mind perpetually awake, and alive to the importance of every subject mediately or immediately connected with it. He reads for his hobby, writes for his hobby, thinks for his hobby; he walks and travels for his hobby, and his hobby preserves him from social contagion and from immoral excesses. Hobby-riding has saved more men than it has ever destroyed. It has given employment to their vacant hours, healthy direction to their thoughts, and amusement to their solitude. It has made them independent of the caprices of society, of individual tempers, of the ravages of time, or the loss of health for enjoyment; it has given wing to their imaginations, and kept up a steady and serene flight in the firmament of fancy, in which the noblest minds have always breathed much and oft. It has promoted discovery and invention, and been the primary source of improvement in the arts and sciences. It has preserved the peace of domestic life, and saved it from the brawls of the drunkard, and the fretful interference of that pest of the kitchen, an idle husband, who sits by the ingle side and grumbles, and gives directions and injunctions to his active wife or servant in household economy. It, in fine, has employed the mind; and from employment it will be found that our best and most permanent personal enjoyments are to be derived. —*Family Herald*.

*Coffee*.—After many experiments, and as many failures, M. Payen has, at length, succeeded in obtaining an extract of coffee in the form of a white crystalline substance, capable of giving a deep green colour to five thousand times its weight of water or spirit. He has ascertained that coffee slightly roasted is that which contains the maximum of aroma, weight and nutrition. He states, that an infusion of coffee, in the proportion of one hundred grammes, (rather more than three ounces) to a litre of water, contains twenty grammes of alimentary substance,—being three times as much as would be the case with an infusion of tea in the same proportions. He adds, that half a litre of coffee prepared as above, mixed with the same quantity of milk, and properly sweetened, is much more nutritive than double the quantity of soup (bouillon). M. Payen refutes the received opinion of the wholesomeness of chicory as compared with coffee; and states that it is destitute of half the quantity of azote that is found in coffee, and is, therefore, only half as nutritive; whilst, in point of flavour and aroma, there is no comparison to be formed for an instant.

*Great Blast at Downhill*.—The *Belfast Chronicle* gives the following account of this affair:—"This much-looked-for event came off on Saturday, and was completely successful. In the early part of the day vast numbers flocked to the place from all parts of the neighbourhood, and placed themselves in groups on various eminences commanding a view of the operations. Eight steamers from different places, one, the *St. Mungo*, from Belfast, conveyed to the scene of action numbers of scientific men, anxious to witness the powerful effects of the heavy charge of gunpowder on the solid rock to be cleared away for the railway. Three flags were raised on a prominent situation to mark the progress of the operations. The taking down of the first was the preparative; the second indicated that all was in readiness, and when the third was struck and a gun fired, the galvanic battery was applied, and immediately, with a booming noise, the tremendous mass of rock, heaving outwards, lay prostrate under the powerful agency skilfully applied to it.

*The Erin-go-Bragh*—A very fine steam-boat of 810 tons burden, designed for the Peninsular service, was launched on Tuesday last, from the yard of Messrs. Ditchburn and Mare, Blackwall. The length between the perpendiculars is 201 feet 6 inches; her length of keel for tonnage is 184 feet 3 inches; and her breadth for tonnage, 28 feet 9 inches; her depth in hold, 17 feet 4 inches.

☞INTENDING PATENTEES *may be supplied gratis with Instructions by application (post paid) to Messrs. J. C. Robertson and Co.*

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## THE LISBURN POTATO-WASHING MACHINE.

Fig. 1.

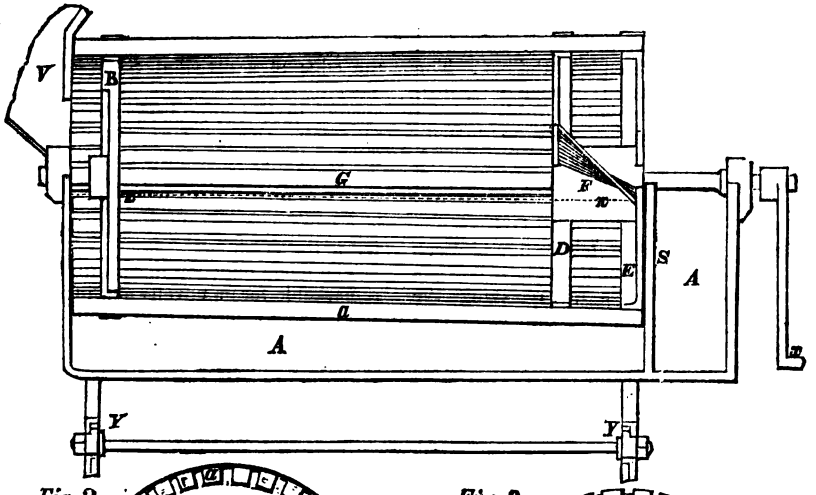



Fig. 2

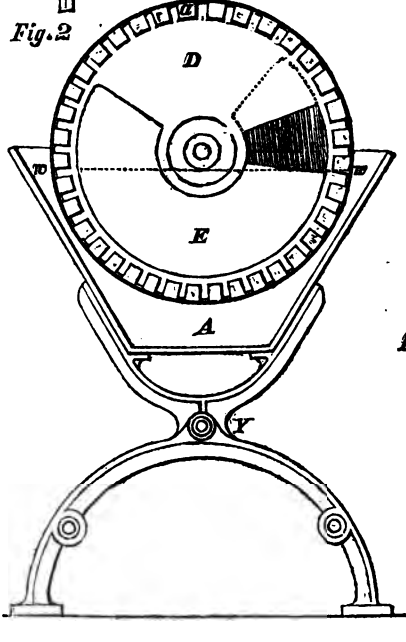



Fig. 3.

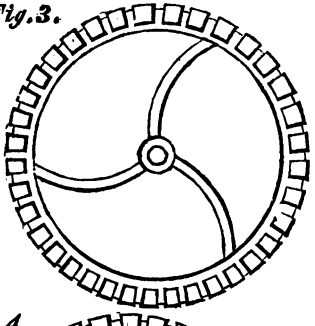
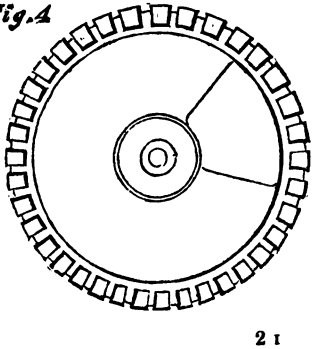


Fig. 4



## THE LISBURN POTATO-WASHING MACHINE.

[Registered under the Act for Protection of Articles of Utility.—Richard Robinson, of Lisburn, Agricultural Implement Maker, Proprietor.]

FIG. 1 of the preceding engravings represents a longitudinal section of this machine, and fig. 2 a transverse section. A is a box which is filled with water to about the line, *w w*, and carried by the standards, YY; C is the washing cylinder, which turns upon an axis, G, supported in bearings in the ends of the box. The cylinder is formed of wooden bars, *a a*, which may, if required, be furnished with brushes on their inner surfaces: they are supported at the feeding end by a wheel, B, (shown separately in fig. 3,) and at the other, or discharging end, by two discs, D and E. The disc, D, is seen in fig. 2; disc, E, separately in fig. 4. Each of these discs and the wheel have recesses on their peripheries for receiving the bars. The feeding end of the cylinder is made smaller than the other end, and the inclination of the bars, *a a*, causes the potatoes, when under the operation of washing, to advance gradually towards the discharging end. When the cylinder is turned by the handle, *x*, in the direction of the arrow, the potatoes pass through an opening in the disc, D, and when between the discs, D and E, they are raised by a grating, F, (supported between the discs,) and are discharged over the edge of a division, S, in the box. They then fall out of the box through an opening in the bottom into a basket placed to receive them. A reverse motion of the handle, *x*, retains the potatoes within the cylinder, and the washing process may be continued as long as desired. V is a hopper, by which the potatoes are fed to the machine.

The mode of action in this machine is remarkable for its novelty and ingenuity, and does great credit to the constructive talents of the inventor. We make no doubt, we shall receive, ere long, good accounts of its performances.

## WILKINSON'S PATENT PROCESS FOR ENCREASING THE EXPANSIVE POWER OF STEAM.

Sir,—I am enabled, through the kindness of the patentee, (D. Wilkinson, Esq.,) to give a description of this invention, which appears to be the most intrinsically valuable discovery relating to steam power since the great achievement of 1830, which united Liverpool and Manchester, and taught the world to annihilate distance.

There is good and bad fortune in inventions; some of the most ingenious contrivances, when carried into effect, are beset with so many untoward physical and practical obstacles, that the invention, but not the inventor, becomes valueless; while others, with no more flattering appearance at the outset, disclose, by closer investigation, greater merit and more extensive application than was originally contemplated. Without the least desire to undervalue the merit of Mr. Wilkinson's invention, I cannot forbear remarking that it is a very fortunate one; for all the facts developed by calculation and experiment have proved auxiliary to the main object—the production of an expansive power equal to that obtained by the ordinary process, with a considerable reduction in the consumption of fuel.

Mr. Wilkinson's principle consists in the injection of a stream of air, heated to the high temperature of from 600° to 800°, into the steam in the boiler, by which means the temperature, and consequently the expansive force of the steam is greatly encreased. This object is effected as follows:—An iron pipe, bent into a serpentine form, so as to present a great extent of surface in a given area, is placed over the glowing part of the fire; one end is inserted somewhere above the surface of the water in the boiler, and the other end is connected with an injecting pump. The whole capacity of the pipe is much greater than the volume of compressed air which it receives at each stroke of the piston, so that the air does not enter the boiler until it has acquired the full heat, or nearly so, of the red-hot pipe through which it passes.

A portion of the power of the engine must necessarily be expended in working the injecting air-pump; it is therefore necessary, in the first place, to ascertain the amount of power lost in that action,

and then see what advantage is gained to set against it.

An experiment was tried on a small engine with a 10-inch cylinder and 12-inch stroke. The injecting pump was 4 inches in diameter, with a 6-inch stroke. Now, if the expansive force of the air in the pump were equal throughout the whole descent of the piston, to the resistance of the steam in the working cylinder, and consequently equal to the pressure of the air in the hot pipe or air-vessel, the portion of power expended in working the pump would be to the whole force of the engine as $\frac{4^2}{2}$ is to $10^2$, that is, as eight to a hundred, or about $\frac{1}{12}$th of the whole power. But it must be observed, that at the commencement of the stroke, the air in the cylinder of the pump is in equilibrium with the external air, and only opposes a resistance as it becomes compressed, and gradually encreases its expansive force until it arrives at its maximum, which is the point of equilibrium with the compressed air in the hot pipe. A considerable deduction must be made for this consideration, and it will be greater or less according to the pressure at which the engine is working; because the greater the pressure, the farther the piston will descend before it arrives at the maximum where the injection commences. Taking all things into account, the whole amount of power expended in working the pump, in ordinary circumstances, may, I think, be fairly estimated at about 5 per cent., or $\frac{1}{20}$th of the force which acts on the piston of the working cylinder.

We must next examine the progress of the air through its fiery path, and the effect it produces when mingled with the steam in the boiler.

The pressure of the air in the pipe, strictly speaking, exceeds that of the steam in the boiler; for it is an excess of pressure that overcomes the resistance of the steam, and forces a passage for the air; but with a communication between the two vessels by an aperture the whole size of the pipe, we may, practically, consider the pressure of the air in the pipe equal to that of the steam in the boiler.

At every stroke of the piston, the same quantity of cold air is injected into the piston, at whatever pressure the engine may be working; that part of the air which was next to the pump is forced further on to a hotter place, and the air which previously occupied that hotter place is forced on to a still hotter one, and so on, till the furthermost and hottest of all is discharged into the steam in the boiler. But this is only the mechanical part of the action; the air continues to flow into the boiler after the action of the pump has ceased; for every part of the contents of the pipe having advanced to a place of higher temperature, the radiation from the sides of the pipe instantly raises the temperature of the air, and causes it to expand and continue to discharge its hottest parts into the boiler so long as, by repeated injections, the air is kept at a lower temperature than that of the pipe.

The investigation of the effect produced by the mixture of hot air with steam, would occupy more space than discretion permits me to ask for—at least at present; and in questions relating to physical phenomena, experiment is most frequently more satisfactory and more accurate than theory and calculation. It may, however, be proper to observe that the chief effect is derived from the caloric imparted to the steam, and not, as in most previous attempts to employ hot air as a motive power, from the expansion of the air itself, which, nevertheless, contributes to augment the power of the engine.

In the experiment above mentioned, it was found that the application of the heated air caused a reduction in the quantity of coals consumed of from five cwt. to seven cwt. per day; and this was continued for several weeks, the engine, of course, working at its usual pressure.

Another experiment, still more direct and conclusive, was made. A cock was attached to the air-pipe, and the pressure in the boiler was noted with the air turned off: it remained steady at about 16 lbs.; when the air was let in, the pressure encreased, in a few minutes, to upwards of 30 lbs.; and this, as well as the preceding trial, was made under very disadvantageous circumstances, the engines not being constructed, as they ought to be, expressly for this system, with smaller boilers, and other modifications which this new source of power requires.

Trusting that this brief description will be sufficiently explicit to arrest the

attention of the "engineering world," I refrain for the present from further comment.

I am, Sir,
Your obedient servant,
R. B.

MISCELLANEA MATHEMATICA.—NO. XIV.

## *Euclid's Doctrine of the Line and Plane.*

Most readers who have considered our previous remarks with attention will acquit us, we are sure, of all captious motives in our criticism upon any part of the ancient geometrical treatises. At the same time, from the concluding paragraph of the preceding number of this series, they will be prepared to anticipate our maintaining serious objections to the ancient compositions upon that branch of geometry which relates to space of more than two dimensions. The subject, in fact, does not appear to be one in which they felt themselves to be masters; and indeed the writings of Euclid are the only ones in which it is really certain that an attempt to embody the discussions in a systematic form was ever made by the Platonic geometers,—or even till very recent times. Isolated subjects, it is true, involving space of three dimensions, were discussed by different geometers; but except Euclid's eleventh and subsequent books, no regular and symmetrical treatise is recorded to have been even attempted by them.

We need only look into a few of Euclid's definitions in the opening of his eleventh book, to be convinced that his grasp of these subjects was less firm, and his views less matured, than when he was treating of plane figures. In fact, *the very style of thinking is altogether different;* and we must confess, that, but for the concurrent testimony in favour of Euclid's being the author of these books, the *internal evidence* against that view is so powerful on our own mind, as to almost lead us to reject the belief of the copaternity of Euclid to the first ten, and to the subsequent books of "the Elements."

Take for instance the definitions of the circle (*i.*, *defs.* 15, 16,) and of the sphere, cone, cylinder, (*xi.*, *defs.* 14—22), as specimens. In the former case the figure is defined by an absolute property, and has a hypothetical previous existence; in the latter the figures are defined by their geneses, and are not hypothetically pre-existent. Those geometers who are familiar with the discussions which have arisen respecting the introduction of the idea of motion into pure geometry, will appreciate the force of this discrepancy;—it is a fundamental one—a discrepancy in the first principles of geometricising. Can two principles so diametrically opposed have been employed by the same geometer? and that geometer one so critically scrutinising and discriminative as the inventor of the *Porism?*

Take as another instance, the dihedral and the solid angle (*xi.*, *defs.* 4, 6, 9,) in comparison with the plane angle (*i.*, *defs.* 9, 10.) In the definition of the plane angle, as we have already remarked, the aim appears to have been to restrict the popular signification of "a household word" to a special signification: — that of only carrying into geometry the *idea of inclination* when we employ the term angle. Surely it might have been thought that as the idea of inclination was so familiar in plane geometry as this use of it shows, it must have been equally clear when referred to a plane as when to a line. At any rate, a sloping wall, a sloping lawn, or a sloping roof, is amongst ourselves as familiar a notion as a sloping maypole, or a sloping beam. Why it should have been different in Athens or Alexandria, it is possible that "profound Grecians" may be able to tell us—but they have not told us yet. Mark, however, how Euclid treats this subject. He defines a plane angle by the inclination of its legs to one another; and then proceeds to define the inclination of two planes by a plane angle! In short, that an angle is an inclination in the first place, and in the second that an inclination is an angle! Again, if a solid angle, he gives only a popular description: it is "*that* which is made by the meeting in one point of three or more plane angles which are not in the same plane." There is in this no allusion to inclination, nor to any characterizing property, beyond giving a name to a figure formed of a certain assemblage of plane angles. We do not, indeed, object to this definition viewed in itself; but mention it as characterising, in connection with the other two, an extremely vague conception of the nature

of angular magnitude in general. In truth, we consider that this is the foundation of the difficulty in which Euclid was trammelled in his compositition of the doctrine of the line and plane.

But to return. We find that his definition of a right angle *in plano* is made to depend upon the general definition of a rectilineal angle, whilst the *dihedral* right angle is conceived, not only apart from the general definition of a dihedral angle, but altogether independently of it. There is, in fact, no reason, *à priori*, that the definition viewed as a particular case (that of the adjacent dihedral angles being equal, *def.* 6,) might not actually clash with that which he has given in *def.* 4; and this consideration is of itself sufficient to prove the illogical character of Euclid's process. Still, our argument so far, is rather intended to show the discrepancy of the views under which the first and the eleventh books were composed, than to enforce the absolute inaccuracy of the process employed in the latter book—though we think it will be difficult to defend even the logic of the parts to which we have adverted. We shall presently consider that book somewhat more particularly under this aspect.

There is another circumstance to which we may call attention under the aspect of discrepancy of manner. It is, that in the very early parts of his first book, the practice of *supra-position* of figures is brought into effective play; whilst in the eleventh book, there is not to be found the slightest efficient trace of the method. At the same time it will appear from the three interpolated propositions, (A, B, C,) of Simson's edition, how effective—nay, how essential—the method becomes in the case where he (Simson) employs it. The reader who goes through those propositions, and notices carefully their functions in some of the succeeding demonstrations, will almost be ready to question our accuracy when we tell them that they are *not* substituted for other propositions which are left out in that edition, but actual interpolations. If he will consider the *hiatus* that existed at this place of the work, he will wonder how such inconclusive results could have proceeded from the pen of Euclid. It is the more remarkable that Euclid should have adopted such a mode of reasoning, or rather have rejected a principle in his reasoning, that would have cleared away so much inconclusiveness with so little real trouble. Neither is it in the case of *conclusiveness alone*, that the rejection of the hypothetical transfer of lines and planes has been injurious to his perspicuity. He might also have conferred upon this subject much greater simplicity, even where the logic is perfectly conclusive, by the adoption of this hypothetical transfer, or by the very effective method which has been employed by the French in their descriptive geometry—the method of *rabattement*.*

These are not by any means all the discrepancies which may be pointed out in the *essential character* of the methods employed in the first and eleventh books of Euclid; but they are of themselves, we think, sufficient to cloud our admission of the same authorship with a considerable degree of doubt. It is, indeed, barely possible that they might have been so composed, at different and very distant intervals of the life of the same person; and if so, our impression would be that the eleventh book was composed long antecedent to the first.

It is *assumed* by Euclid, and that without even giving the formal statement of it as an axiom, that if two planes which meet be cut by two profile planes,† the angles contained by the one pair of lines of section is equal to the angle contained by the other pair. Is this really so obvious a truth as to justify its assumption without even formal specification? Is it more obvious, for instance, than (*Prop.* xvi.,) that "if two parallel planes be cut by a third plane, the sections will be parallel?" Is it more obvious than (*Prop.* x.) that "if two straight lines which meet one another be parallel to two others which meet one another, though not in the same plane with the first two, the first two and the other two shall contain equal angles?" Thus much, at least, is certain: that as a proposition it admits of a legitimate demonstration; and that this demonstration cannot be (at least it

* It is worthy of remark, however, that though the principle of *rabattement* is used in the first and second propositions of the eleventh book, it occurs nowhere else; though it would have been very effective in other parts, and is in those particular ones unnecessary.

† We use this word in a sense sufficiently familiar to most of *our* readers; but it may be worth while to state generally, that *the profile plane is that which is perpendicular to the intersection of the other two.*

never has been) effected without the aid of the last-quoted proposition, or something tantamount to it. Not only, therefore, is Euclid's conception of an angle defective in point of clearness, but the reasoning by which he proceeds in the use of it is inconsequential and, therefore, invalid.

We have already referred to Euclid's rejection of the method of hypothetical supra-position as an instrument of demonstration. The treatment of the equality of two dihedral angles is a case in point, not only of the advantage, but of the almost absolute necessity, for its employment in this branch of Geometry. He defines the equality of two "inclinations," by the equality of their corresponding profile angles; whilst in his first book he establishes the equality of two angles by showing the necessary coincidence of the position of their containing legs,—the hypothesis of the theorem and the transposition of the fixing parts of the figures being admitted. Most of the French geometers who have even adopted Euclid's definition of the dihedral angle have seen the necessity of proving the equality of all profile angles made in the same pair of planes, of which necessity we have already stated our own views: but the more recent authors have adopted the method of supra-position in this argument, with such good effect as might have been anticipated. Perhaps, however, Lefebure de Fourcy, (in the introduction to his Descriptive Geometry,) has carried it out with more of the elegant simplicity that characterises his writings than any other author—not excepting even the clear, concise, and perspicuous Vincent; or the careful, scrutinizing, and cogent Legendre.

An opinion seems to have ever prevailed that the line as a geometrical element is a simpler object than a plane; and this has always exhibited itself by elementary writers bringing it into consideration *previously* to the plane. All our works on Analytical Geometry, too, where we should have expected the equations themselves to have impressed a contrary doctrine in the mind, bear witness to this prevalent notion. Such writers are, however, for the most part, mere routinists—their only difference, each from his predecessor, being in some matters of mere detail, and never ascending to anything connected with general principles, and least of all with first principles. If we may use a homely comparison, (of more force perhaps in earlier times than in the present,) we should say, that the first writer on any such subjects is "the bell-wether whose tinklings the whole flock instinctively follow." The individual components of the herd may turn a few feet to one side of their leader's track or to the other, to avoid their mutual jostling: but the same general line of march is preserved by all, and kept as faithfully as if their scientific safety were perilled by any marked departure from it. All men possess the "right of private judgment:" but how few are able to avail themselves of it, even when conceded to the full!

In respect to the doctrine adverted to, Euclid appears to be the great "bell-wether." The most remote and complex case of perpendicularity in a natural system, is that of the *line to the plane*; and this is testified by the complexity of the definition of this case of perpendicularity given by Euclid, and after him by every writer on the subject. It is even a subject of ordinary discovery by intelligent and attentive students, to whom the definition is for the first time propounded, that it assumes too much, and that for aught which appears, the things assumed may be incongruous with each other.

A good deal of artificial inconvenience is created by the practice of giving the *entire* of the definitions relating to any one mathematical subject, in the outset of a book or section. Some writers (amongst English ones, Lardner and Leslie, and amongst the French, Vincent) wait till a definition is *required*, to introduce it; and it has been attempted by some metaphysicians to meet the objection to which we have just adverted, by viewing it merely as misplaced in the development of the geometrical system. Were this, indeed, all the objection that we feel to Euclid's fouth definition, we should have scarcely thought it needed any specific notice. It is, no doubt, proved, (and proved, too, by Euclid with an elegance fully equal to that by which any other author has proved it,) that "if a straight line stand at right angles to each of two stright lines at their point of intersection, it shall also be at right angles to every other line passing through that point and situated in the plane which contains those two lines." It therefore follows, that a straight line *can be* at right angles to every line passing through a given point in a

given plane, *if it can be at right angles to two of them.* It is remarkable, however, that Euclid nowhere proves this proposition; and that the writers who have attempted it are extremely few. We do not at this moment recollect any English writers except Cresswell* and Lardner who have considered this to be necessary. Neither of these authors has, however, made any material impression on the public mind.

The mere absence of a clear a proof is, undoubtedly, a serious objection, in such a writer as the author of the "Elements:" but it assumes a graver character when looked at in reference to its implication of the state of his views on the subject. The fundamental canon of logical definition is violated in this case: viz., "to give as many conditions as shall confine the thing to be strictly what it is, and no more." If too few, the definition so given may belong to other things besides that under consideration, and is therefore incomplete: if too many, the added ones must be either superfluous or contradictory. If superfluous, they are *properties* of the figure defined, and hence require a *proof*, subsequently to, and dependent on, the definition itself.

By a different arrangement in the order of consecutive dependencies, all this might have been avoided; and the antecedent consideration of the dihedral angle would have removed much of the confusion of ideas—yes, the whole—of which most persons are conscious, when they have read the first half of the eleventh book. We hold that perspicuity is the first and highest test of the naturalness of a scientific development; and in this respect, the book in question is singularly deficient.

But even if we adhere to Euclid's own arrangement in this respect, the superfluous conditions, which are introduced into his definition of a line at right angles to a plane, ought to have been avoided,—as evidently they might with the greatest ease have been, under the influence of a clear conception of the subject. For instance, take the following obvious route:—

*Def.* "When a line is perpendicular to any two lines in the plane, at their point of intersection, it is said to be perpendicular to the plane."

*Prop.* "When a line is perpendicular to a plane, it is perpendicular to every straight line in that plane which meets it."

This, we believe, is very nearly the form in which every careful student is led by his own reflections to place the matter; and under this form, too, we know that some of our most able teachers are in the habit of placing it before their pupils' minds in the outset.

Another singular instance of Euclid's vagueness is in *Prop.* vii. of this book. He has framed that proposition merely for its use in the next:—whilst it is contained entirely in the definitions of the plane and parallel lines. Thus, the lines being parallel they are in one plane; and a plane superficies is that in which any two points being taken, the straight line which joins them lies wholly in that plane, *defs.* 35 *and* 7, *book i.* These are definitions only, and as the "proposition" follows without the aid of an axiom, or the use of any theorem, it is only a modified statement of congruity of the two definitions we have quoted. Euclid, however, not perceiving this has given a formal demonstration, *ex absurdo.*

We grant that the arrangement and dependent demonstrations of the 4th, 5th, 6th, 8th, 9th, and 10th propositions follow each the other with much elegance; and, indeed, we consider this particular feature to be the main beauty of the eleventh book. At the same time, this entire series would find a more fitting place much further onwards in the development of the subject. They are more akin, especially the first named four, to the 18th and 19th, and would be advantageously placed posterior to them, provided these themselves were demonstrated in the way they might be.

It is unnecessary to dwell further on these topics, than just to allude to the extremely *gauche* demonstrations given, not by Euclid only, but by most (all?) subsequent writers, of *prop.* 21. Euclid, indeed, only gives the first case in his demonstration, the trihedral angle,

* Cresswell, from his writing during the transition-period of the Cambridge mathematical taste, was treated with a neglect that was perhaps natural under the circumstances, but which we are sure is a most unjust criterion of the value of his works; and Dr. Lardner had to sustain, in respect to his writings, a large share of the hostility which was brought to bear upon the then newly-founded college in Gower-street,—whose interests admitted of being wounded through his side. We are, indeed, as well aware as the most captious of our readers can be, that Lardner's works are very unequal; yet they bear undeniable marks of intellectual ability, and his Euclid certainly possesses many meritorious points—although we would not be understood to recommend it as a whole.

though he enunciates it generally; the second or general case of the demonstration is by Simson; and the *cor.* 1, *prop.* 32, *book* i., is interpolated by him for that purpose. We shall hereafter propose a new demonstration of this property, much more simple and intelligible, and equally conclusive with that in the "Elements."

We have dwelt at greater length than we intended upon these topics; and yet have not put down the half that we could urge in favour of our view of the subject. We have, indeed, touched many of the points to which we have adverted too lightly; but we have only expressed our honest convictions formed many years ago, and enforced by every subsequent year's reflection on these questions. Should mathematicians be found who differ from us, all we ask of them is, to scrutinize the solid geometry of Euclid, with the same honest and earnest desire to arrive at correct views that we have done; and should they then be led to entertain an opinion different from ours, we shall still entertain the same respect for them that we should in case of their proceeding further in our own route than we have done. We feel convinced, however, upon one point:—that whatever opinion any geometer may entertain as to the merits of Euclid's development of the geometry of space in a *logical* point of view, no one will be found to contend for its *completeness.* Properties fully as numerous as those which he has given of plane triangles are required in the *application of solid geometry to practical purposes;* and that without our going further into the subject than the inclinations, parallelisms, and perpendicularities of lines and planes, and the trihedral angle. The pyramid, cone, cylinder, and sphere, to say nothing of the general surfaces of the second order, are also *essential* objects of study, when we study with a practical aim. Will any one contend for the *completeness*, then, of Euclid's writings on this subject?

We scarcely need add that we would would on no account recommend Euclid's twelfth book as a subject of professional study,—nor even the latter half of the eleventh. They all relate to quadrature and cubature; the truths at which they arrive are very limited; and the reasonings by which they are obtained, (though the "method of exhaustions" is a very subtle and refined method of proof,) are so much more complex than more modern forms of demonstration, (albeit, the same, or nearly so, in principle,) as to render it an almost entire waste of time to enter into them. They are amongst the very simplest of the applications of the Integral Calculus; and even without having recourse to that method, the method of limits, which is by our best writers considered the true foundation of the calculus itself, will enable us to obtain truths far more recondite and general than those at which Euclid has arrived. "What, then, Mr. Editor, do your recommend?" We will answer *presently.*

## ATMOSPHERIC RAILWAY TUBE WITHOUT VALVE.

Respected Friend,—I beg to submit to thy notice a plan for facilitating the working of atmospheric railways; this plan may possibly be susceptible of improvements, but I consider that the principle is such as to warrant the supposition that it is calculated to remove many obstacles to the more universal adoption of the atmospheric system of propulsion.

In the *first* place, as there is no valve, leakage cannot possibly take place, and if I may be allowed to give an opinion, the result of a vast number of experiments, I do not believe that it is possible to keep a tube air tight with a valve of any kind, by any process. Robert Mallet's is, in my opinion, the best, and it is probable that under ordinary circumstances, the leakage would not be very considerable, but a trifling casualty would have a great effect in preventing the vacuum being maintained—such as, the melting of the sealing compound, or dust being driven around the hose-pipe, which would prevent its being sealed hermetically.

In the *second* place, there is no complicated machinery; neither can the piston outstrip the train, an accident which, it has been objected, might take place on Pilbrow's plan, although much ingenuity has been undoubtedly expended in maturing it.

*Thirdly*, the speed can be diminished in descending an incline, *and the train can be stopped at intermediate stations, or at any part of the road, as easily as a locomotive.*

Fig. 1.

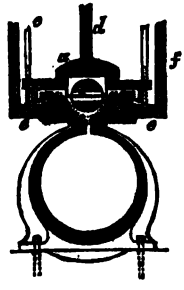



Fig. 2

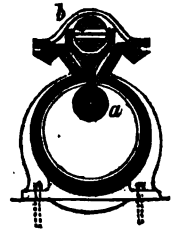



Figure 1 is a section of the tube; there is a longitudinal slit in the top of it, of only five eighths of an inch in width; but immediately above it, there is a groove which gradually widens towards the top, so as to be 7 inches wide, and 6 inches deep. This groove I cover with vulcanized India-rubber, firmly fastened at the top by means of wood previously fastened to the iron; the India-rubber is indicated in the figure by the dotted lines; it is half an inch thick, but thicker in the centre where it would be more liable to wear. It will be seen that although the groove is very wide at the top, the pressure of the air could be exerted only on that part of the India-rubber which would be over the opening of the tube; the upper piston, *a*, slides in small grooves at the side of the tube, by means of small wheels, and in the centre of it, at the end, is a round metal ball, *b*, turning on a horizontal axis. Figure 2 represents the inner piston in the tube; the upper part of this piston drives the upper piston, *a*, fig. 1, by raising the India-rubber; the metal ball, *c*, figure 2, revolves also on its axis, so that there is very little friction. It will at once be seen that as the inner piston proceeds, the India-rubber which is at the bottom of the groove over the vacuum, is raised as at *b*, fig. 2, and as the piston, *a*, fig. 1, cannot be raised out of its position, it must proceed with the train to which it is attached by the rod, *d*. A small wheel might be attached under the carriage to press down the India-rubber, but of course it would descend in the groove as soon as the air was pumped out from the tube. To stop the train, all that is required is to turn the screws *c c*, very rapidly; they might be turned both at once by being connected with cog-wheels furnished with a lever, worked by the hand or by atmospheric pressure. The screw being turned, the long breaks, *e e*, would be pressed against the iron of the tube, and the upper piston, *a*, would be pressed down, when a greater amount of friction would be obtained, as the metal balls, *b* and *c*, would cease turning on their axis, and the train would gradually stop. It is difficult to say at what distance the train would proceed after turning the screws, but I presume that it would stop as rapidly as a locomotive. To check the speed of a train in descending an incline, the same mode would be adopted; only a less power on the lever would be required. The long breaks, *e e*, would be about 8 feet in length, and being fastened to the carriage by the rods, *ff*, would not touch the iron of the tube except when the screws would be turned.

But there is one objection which may be brought against this plan—that is, that the India-rubber would in time wear out. I do not mean to attempt to refute this, for as iron rails wear out by friction, it must be taken for granted, that India-rubber would wear out also. What we have, therefore, to consider is, whether it would last a sufficient length of time to be used with economy. To this I can only answer on the faith of several individuals, who have informed me that the friction which vulcanized India-rubber will bear is almost incredible. If such is the case, I think that this plan may answer; for although other objections may possibly be brought against it, I feel confident (in my own conceit) that

it would answer the end proposed—namely, the economical mode of working atmospheric railways.

The India-rubber might be covered with some waterproof substance which would not dissolve easily by heat; a compound of bees'-wax, talc, and iron filings will bear a great deal of friction without being injured, if laid down evenly; but many other substances might be used with advantage for that purpose.

I remain respectfully,

JOHN DE LA HAYE.

London-road, Liverpool, 6th mo. 11th, 1846.

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OBSERVATIONS ON PROFESSOR G. A. MAJOCCHI'S ESSAY, "DELLE IMAGINI PRODOTTE DU ESALATIONI VAPOROSE SOPRA LE SUPERFICIE DEI CORPI." [ANNALI DE FISICA CHIMICA, ETC., NO. VIII., 1844.]

*By Horatio Prater, M.D., Ph. D.*

Professor Majocchi, after an able review of all that has been written on this subject in England, Italy, and Germany, proceeds in the present memoir to give his own opinion on the subject—which is, that Moser's images depend neither on light, heat, electricity, nor chemical attraction, but on "*molecular attraction.*"* "Sappiamo," continues he, "infatto che nei pauti d'un corpo, sui quali si esercita un' azione mechanica chimica o fisica mediante un altro corpo od un fluido imponderabile, si altera la loro forza attrattiva d' affinita o di semplice adesione coi vapori o colle esalazioni di certi sostanze," (p. 188.)

It is satisfactory in this essay to see that the professor rejects the opinion of the action depending upon the imponderable agents, light, heat, &c.; for I think we shall find that his "attrazione molecolare" is in reality scarcely to be distinguished from a slight change in the chemical affinity of the plate, or if so, it will only be the same as Berzelius's catalytic force which Mitscherlich has lately shown is to be considered a peculiar power of attraction inherent in the *surface* of matter—it will, in short, be something tangible or intelligible. In my essay on the subject, I came to the conclusion that the images depended, "on a chemico-mechanical action, meaning thereby an action so slightly chemical, as in the present state of the science to be scarcely appreciable;" and I think the professor not warranted in rejecting all idea of chemical action. In fact, in parts of his paper he seems to consider that the action is in some circumstances slightly chemical. Thus, in reference to Karsten's experiments with the electric spark from the prime conductor discharged on the medals placed on a plate of glass, Majocchi expressly says, the image in this case seems dependent on electricity, separating a very minute portion of potass from the glass; and in those parts of the glass in which the potass is separated, there is necessarily less attraction for the moisture of the breath, hence the image.*

After passages like this (for I think other expressions of a similar nature are to be found in other parts of his essay,) I cannot really see much reason for his wishing to alter the terms in which I express the general principle, which I conceived I had discovered on the subject. I said, the less the metals are oxidable by exposure to the air, the less they are susceptible to receive images.† The professor would rather, he says, have it thus ("il quale noi cambieremo piuttosto in quest' alto.") "The less the metals are susceptible to be altered in their attraction of superficies, the less suited they are to give place to the production of images."‡ I found gold and platinum unsusceptible of taking the images, and silver less so than copper, and, certainly, the three former are less susceptible of oxidation from the air than is the latter; but I do not know that any person is warranted in saying that the attraction of the superficies of copper is more easily changed than that of gold, platinum, or silver. What authority *from experiments*, have we for making the assertion? If the authority rests merely on the results obtained by me on the subject, I cannot consider it adequate to support the professor's views on the subject; he surely ought to be able to adduce experiments either by himself or others in which gold and platinum were found less susceptible of change in their attraction of superficies than copper. But judging

* L'Unica et generale causa, &c. &c., p. 188.

* "Ora si sa che la potassa attrae l' umidita d pui degli altri componenti il vetro, &c., &c.," and he quotes from Gilbert's Annalen to show that the electric spark has been shown by experiments to have this effect.

† Prater dalle sue speriense deduce, &c., &c.

‡ Meno i metalli sono, &c., &c., (p. 195.)

from its effects on a mixture of oxygen and hydrogen, one would consider that platinum had a very strong attraction of superficies—*at least, as regards these gases;*—but as regards hydrogen and nitrogen as existing in ammonia, one would imagine *copper* to have a stronger attraction of superficies—at least at the heat of incandescence—since copper will affect the decomposition in this case that platinum turnings cannot (Mitscherlich). But the fact is, that of this attraction we seem as yet to know little or nothing, and therefore cannot form a correct estimate in what metals it is stronger, in what weaker.

Soon after completing my essay on Moser's images,* I conceived that the oxidation which in copper plates was obvious, was accelerated by *contact* (as the contact of heterogenous substances generally seems to excite electricity,) and this view, together with the idea that Berzelius's catalytic force had by Professor Grove's discovery been proved in the case of platinum, oxygen, and hydrogen, to be electricity, I communicated a few days afterwards to the editor of the *Athenæum* as a supplementary note to my essay. It was not, however, published; but I still retain the opinion that electricity may be concerned in the production of the chemical effects when they occur.

I may here add a few more experiments made by me on this subject since reading Professor Majocchi's essay, showing that a weak electric current does not enable copper to receive images through the *thinnest possible* lamina of talc, and thus further confirming the opinion expressed in my essay that the images are not due to the action of any imponderable agency ACTING AT A SENSIBLE DISTANCE from the plate.

*Exp.* 1.—I placed a silver coin so that half of it rested on the *thinest possible* lamina of talc placed on a copper plate, and half on the copper plate itself. I then put a piece of zink, with one end on the top of this coin, and the other touching the copper plate, and at this part, between the metals, I put a small quantity of water.

Although the coin rested in these circumstances forty-eight hours, no part of it was visible on the copper plate except the part that had been in *immediate contact* with that plate. The impression had not passed through the talc.

* Has this anything to do with the power of preserving from oxidation?

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ON KARSTEN'S ELECTRIC THEORY OF THE MOSER IMAGES.—(SEE TRANSLATION IN ARCHIVES DE L'ELECTRICITE FOR OCTOBER 24, 1844.)

*By Horatio Prater, M.D., Ph. D.*

Soon after the commencement of his paper, Mr. Karsten says, when a thin plate of mica is interposed between the medal and metallic plate, no image of the medal is formed even after six weeks, but only of the mica—*i. e.*, (as I observed many months before the essay under consideration was written,*) only of the substance in *immediate contact* with the metallic plate.

Drawing the same conclusion which I had previously done from this experiment, viz., that it was a satisfactory objection to the cause of the phenomenon being invisible light,† (light passes through mica with facility,) he still considers it rather in favour of the figures depending on electricity; for, says he, mica is a non-conductor. But, as the figures do appear through mica when a higher degree of electrical tension is present, (an electrical machine being used,) he thinks a certain degree of electrical tension is necessary for the production of the figures in question, (page 461.) But where, I would ask, is this electrical tension, when figures are formed by mere contact, and contact, too, of substances which have not even been shown to produce electricity? For I found, for instance, that *everything* I put in contact with the plate, left a spectrum after a certain time. Again, let us turn to page 466 of the same essay, and we shall see Mr. Karsten himself stating that neither he nor others have been able to produce the figures by the voltaic pile; but he adds, "I attribute this to the experiments having not been properly made," and says, he is going on with others to clear up this difficulty.‡ It

* *Athenæum* for 20th May, 1843, and *Mech. Mag.* for 27th May, 1843.

† In this same experiment, finding when the plate was even heated, no image was produced, I also concluded the images did not arise from heat.

‡ The experiment made by me, and related in my preceding observations (page 490) on Majocchi's Memoir, also goes to support the opinion that voltaic electricity is not concerned in the effect, or only indirectly so, as favouring chemical action.

would probably have been as well if he had made these experiments before he published this essay, herein expressly calling the figures "electrical," and thus tending to throw the appellation "Moser's images" into the shade.

Again, he relates an experiment which he also says "has need to be repeated again, (*qui a besoin d'être répétée encore*, page 464,) since it also goes against his theory. A silver coin being placed on a brass plate, was connected also with the exterior of this ("*tout autour l'exterieur*") by a band of copper; nevertheless, an excellent image appeared when examined three days afterwards, though, as he admits, the electric current had been neutralized by the copper band. In the same way it formed, though not apparently so perfectly, when the coin and plate were put between two plates of glass.

Mr. Karsten, however, in his fourth observation, (page 464,) denies what certainly appeared in my experiments to be a fact, in order to support his hypothesis; for he says, "*no image* is formed when homogeneous bodies are placed on each other, and having the same temperature."

I found that copper on copper, as nearly as possible at the same temperature, still gave an image, though less feeble than when there was greater diversity between the metals.

Notwithstanding that Karsten finds he can produce Moser's images through a plate of mica by the *electrical machine*, all the above facts ought surely to have rather led him to the conclusion that images may probably be produced by different causes, than to have attempted to refer all to electricity. Thus, for instance, I stated in my experiments that when water was interposed between the plate and coin, the impression was still stronger. But, Sir, the action depended certainly on a chemical cause. M. Majocchi, in his memoir, if I mistake not, was inclined to refer the images made by high electrical tension (electrical machine) to a sort of mechanical agency. And, certainly, these sparks from an electrical machine have much of the character of *compression*; in which case, equally as by obvious chemical action, the figures would necessarily be expected to be stronger than when produced under the circumstances first employed by Moser. There are, then, more causes than *one* for these images or impressions; and it was not enough for Mr. Karsten to show that by the electrical machine he could also get these images through mica; he ought also to have shown he could do it by the voltaic battery, and also that when the current was neutralized they also appeared. But this, we have seen, he confesses he has not yet been able to do.*

In his memoir on this subject, published in the July Number of the *Archives* for 1843, Karsten admits that the figures are scarcely produced on glass, except there be a plate of metal below this, so that the sparks from the prime conductor going from the medal can fall on the plate of metal placed below the glass, thereby, as he says, forming a kind of Leyden jar. At page 313 of this memoir, he seems to think, on finding the engraving very clear after an unusual number of turns of the machine, that a little nitric acid was formed; we may add, that *probably there is always in these cases an increased tendency given to the plate to oxidate*; for we know, by Wollaston's experiments, and by others, that even common electricity is, under certain circumstances, an oxidizing agent. However, as these images do not seem capable of being produced by the galvanic pile, this fact would rather tend to place them among mechanical than chemical forces. Karsten himself, in this paper (p. 319) says, it is rather in change of cohesion than in the light that the cause of these images is to be sought. Electricity acts, then, like more purely mechanical or chemical forces, by altering the cohesion.

The very superficial way in which some of Karsten's conclusions are drawn, may be observed from the following way in which he endeavours to show that these figures are produced by magnetism equally as the common electrical machine. "A medal of iron left on a steel mirror '*quelques moments*' (page 320); the image of *the border* of the medal became apparent on breathing on the plate." Why the same effects would, no doubt, have arisen had a well-polished copper plate been used. He con-

* At page 470, *et. seq.*, Karsten himself does admit there has been a confusion on this subject between chemical images (produced by oxidation,) strictly so called, and Moser's images, and attempts, on these grounds, to show that Messrs. Hunt and Knorr have altogether mistaken the subject.

fesses he tried no experiments with *electro-magnetism*, but gives this experiment as favourable to *magnetism* having power. In two experiments previously, with a voltaic battery of forty pairs, he was unable to produce any image by this kind of electricity. On the whole, I cannot consider the production of images through glass or mica by means of the common electrical machine (where so much *mechanical force* is necessarily produced by the electric spark) as having more than a very distant (if any) relation to Moser's images; and certainly, such experiments have not in the slightest degree made me alter those opinions already expressed on the subject in my first memoirs. Every consideration convinces me that no mysterious, imponderable agent is concerned in these effects at all similar to that which acts in living bodies, and produces many at present inexplicable phenomena. It was to ascertain whether this were the case, that I undertook the laborious series of experiments published in the *Athenæum*, and I leave the subject in full confidence that no such agent is employed in this purely physical phenomenon.

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WILME'S HANDBOOK FOR MAPPING, &c.*

Adam Smith, it is said, considered man to be the most untransportable of all the commodities that come under the ken of "political economy." That was an undoubted truth in his time, but would be an antiquated prejudice in ours,—except, perhaps, as applied to the agricultural population of England. Man is more distinguished in our period by his passion for locomotion, mental as well as corporeal, than for his *vis inertia*. Nothing is become so distasteful as a life of uniformity, and to be really agreeable, even the highest velocity of our movements must be chequered with diminished speeds, comfortable stations, and luxurious refreshment rooms. Our very business must have its changes, and our occupation its manifold varieties. *Ne sutor ultra crepidam*, that wise maxim of the Roman, or its counterpart in the wisdom of our ancestors, "Let well alone," is become an antiquated dogma, and every man considers it preferable to live in some other way than by means of the profession or handicraft to which he was educated.

In no case, however, has there been such an extraordinary influx of "strangers" into any pursuit as into that of engineering,—and especially the surveying department of railway-engineering. For the last few years it has been the *El Dorado* of English adventure—the Aladdin's lamp to the "genius" of humble life.

We well recollect the time when surveying was almost exclusively confined to estate and parochial purposes—that there was a kind of mystery hanging over it in the popular estimation. It was then something wonderful; and those who practised it were esteemed if not quite "conjurors," yet "deuced clever fellows." The idea of a man telling the magnitude of an object from merely measuring a line somewhere else, and "looking through a spy-glass at each end," was not unnaturally, by the then ignorant populace, considered as something near akin to magic; and it did, in relation to the general acquirements of the multitude, justify the character of constituting "high larnin'." The public instruction has, however, proceeded so far, as to enable schoolboys to master that mysterious identity, the idea of an angle!

It would appear that this item of popular acquirement has removed all obstruction to "surveying" becoming all but intuitive, and that whilst it is pompously dignified with the name of a "profession," it has likewise become as an unappropriated district, upon which every "squatter" may pitch his tent, without molestation or challenge. We doubt, indeed, whether the entire of the classes that "live by their wits" number half so strong as the impudent varlets that have within the last four years invaded the province of the properly educated and intelligent surveyor. We hold that a properly qualified surveyor must be at least a moderately good mathematician, possess a well-trained eye, a degree of pictorial taste, and be, withal, a respectable draughtsman. Yet we see daily advertisements of charlatans who profess to "teach" all this in six or in eight lessons! Nay, more, to "guarantee proficiency!" In our estimation these persons ought to be brought under the surveillance of the law as much as the gipsy palmist, or the "cunning man" who reveals the rural theft—that law which applies to *rogues and vagabonds*. Perhaps, indeed, the law of the "ducking-stool" and "riding the stang" may bear equally well on the case; but as these are become obsolete in London and the large towns, we must trust to the tender mercies of our police-magistrates for the abatement of the nuisance.

* "A Handbook for Mapping, Engineering, and Architectural Drawing, etc. Illustrated with forty-three large plates, and thirty-nine woodcuts. By B. P. Wilme, Civil Engineer and Surveyor. 4to Weale, 1846.

How many thousands of pounds have, even during the last autumn, been sacrificed by the impudent impostures of these very men, in the case of railway schemes broken down upon the *standing orders*, by the extraordinary falsehoods introduced by them into their plans and sections!

We have no intention to enter here upon the general question of apprenticeships, nor are we disposed to enforce that a man shall have gained this knowledge in any prescribed school or mode of practice; but we are, and always shall be prepared to contend for the necessity of persons professing *skilled* work (whether implying high intellect or little) being subjected to a previous examination as to their qualifications, and obtaining a certificate authorizing them to practise.

The ordinary practice of surveying does not, indeed, hold a high intellectual rank in the engineering profession; but still it holds a respectable one, and the qualifications which we have noted as essential, require time, patience, practice, and perseverance, as well as moderately good mental powers for their acquisition. We do not, of course, include in this statement the higher geodesy, which requires for its successful practice all the functions of the astronomer conjoined to the most delicate refinements of analytical science. These qualifications, of course, are but seldom found; and we regret to say that even those for the ordinary surveys required in civil engineering are far more rare than is usually imagined. At present, *nearly all* surveyors pursue a routine system, of the grounds of which they know little—often neither know nor care. Even on this principle, were the routine founded on accurate science and good taste, there would perhaps be less real objection; but it always happens, somehow or other, that the most illiterate person is a "man of genius," who despises the sensible laws of routine, and launches forth into a system of his own, which never fails to prove the more absurd and disastrous, the more of his own genius it displays. Concentration of employment into large offices, will, however, tend in some degree to cure this by confining the operatives, each to one small section of the entire operations.

Of course, in every large office, it will be found advantageous to divide the work as much as possible into separate departments, and such, we know, is the general practice. This division very naturally forms itself into:—

1. The plan of the survey, which requires the master mind of the office.
2. The field work, and its record.
3. The computations.
4. The plotting and finishing the map.

It is to the last of these that Mr. Wilme has addressed himself in the work before us; and though with too much "writing downward" to meet the presumed ignorance of his readers as to the most elementary mathematics, we think he has produced a *very useful* book. Indeed, *utility* is his professed and obvious aim, and he who does well what he proposes to do, whilst his aim is a really useful one, deserves our most cordial approbation. This we are happy to be able, in the main, to award to Mr. Wilme. On the other branches of surveying, there is no dearth of treatises, such as they are; but upon this, nothing more than a few scattered, and often unintelligible remarks are to be found in print—except, perhaps, amongst a few military translations from the writings of the French Engineers, which are scarcely applicable to the wants of the civil surveyor in England.

Whoever has been, like ourselves, in the almost daily habit of inspecting plans and drawings of all kinds, must have been often strongly impressed with the necessity for a better pictorial taste being diffused among our operative draughtsmen. We can bear our own testimony to the too general truth of the faults pointed out by Mr. Wilme,—

"1st. An unevenness in the thickness of the lines, which should be of the same thickness throughout, and a certain shakiness or crookedness in lines which should be perfectly straight,—as fences.

"2nd. The unsightly prominence of some portion or portions of the map, possibly a portion which should, (to use an artist's phrase,) *be kept down*.

"3rd. The unmethodical representation of natural objects, a poverty in the writing and detail generally, some parts of it being very much overlaboured, and other parts equally neglected."

Mr. Wilme is an advocate for a systematic notation in maps, and a spirited touch in their execution, and in addition to this, his precepts for accomplishing these desiderata, and the examples by which they are enforced by the plates, cannot be recommended too strongly to the notice of the young practitioners in every office. We are led to think, indeed, that the profession generally will be both gratified by the symmetry of the system here laid down, but benefited in no slight degree by its uniform adoption.

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### THE "GREAT BRITAIN" STEAMER.

The last passage out of this steamer turns out to have been longer than those

which she made before the alterations in her machinery. (See page 418 of our current volume.) But this appears to have been owing to an accident which made it necessary to disconnect the screw during a considerable portion of the passage, for the average speed was much greater than on any former occasion,—being 11¾ knots, equal to 13½ statute miles. We extract from the American papers the following abstract of the vessel's log:—

"Left Coburg Dock, Liverpool, at 9·55 A.M., on the 9th of May, came north of Ireland, and to the time of clearing the land, at 3 A.M. of the 10th, the ship averaged 11¾ knots or nautical miles per hour, part of the time under canvass; then met a strong westerly wind and a cross-sea. Broke the guard of the after air-pump on the 13th, and have been altogether six days without steam—sailing with the screw disconnected. The new rig answered well, making 9½ knots at times, close hauled, and 11¾ a point or two free. This only for a short time, as the wind very soon hauled against us. Since the temporary guard has been working, we have gone at less than half speed. The passage, therefore, under the circumstances, has been excellent. I find the Belgic keels have lessened the rolling materially. Crossed the banks in lat. 45, and saw no ice. Rounded Nantucket Shoals soon after noon on the 28th, and passed Sandy Hook at 9·15 A.M., 29th, making the passage in twenty days."

## SCREW PROPELLING.

### *The Judgment in Lowe* v. *Penn.*

(May 26, 1846.)

[We stated two weeks ago, that a new trial had been granted in this case. We now give a verbatim report of the judgment of the Court, which we are induced to do, not only because the question involved one of great interest to our readers, but on account of the *new point* which it will be seen has been raised by the Court as to the sufficiency of the plaintiff's specification, and which has an important bearing on specifications in general. ED. M. M.]

*Chief Justice Denman.*—In the case of Lowe and Penn: This was an action for the infringing a patent. A verdict having been found for the plaintiff, a motion has been made for a new trial, partly on the ground that there was no infringement of the patent by the defendant, but also, and principally, that the patent itself is void, because the alleged invention is not new. That invention is, by the specification and description of the drawings, both of which are referred to for the purpose, stated to consist in a mode of propelling vessels by means of one or more curved blades, set or fixed on a revolving shaft below the water line of the vessel, and running from stem to stern of the vessel, and it is added, that each of the curved blades is a portion of a curve which if continued would produce a screw. On behalf of the plaintiff, it was not contended that every part of it was new, but that the invention consists in a new combination of those parts; the essential part of that invention being, that the blades must be curved, and each a portion of a curve, which, if continued, would produce a screw. And first, as to the point of infringement: we think it to be indisputably clear, that most of the component parts had been in use, or known before the date of the plaintiff's patent. This was established by proof of the earlier patents of Shorter, Trevethick and Cummerow. In these, or some of them, the position of the machine, that is to say, the aperture being in the dead-wood, the direction of the shaft, with reference to the keel and stuffing-box and curved blades were the same, except indeed that those curved blades did not form each a portion of a curve, which, if continued, would produce a screw. That at least was not shown, and that, as we have already shown, is the characteristic distinction of the alleged invention of the plaintiff, on which reliance is mainly placed. The question, therefore, as to the infringement comes shortly to this; whether in the defendant's machine curved blades of that particular description have been used or not; because, if they be not curved, but plain, or flat blades, it is obvious that by no number of revolutions would they, or by any possibility could they produce a screw. We are quite aware that there was evidence that the blades of the defendant's machine were curved; but the models which were pronounced to be curved, have been exhibited, to us, and upon actual, and we may add, upon a most attentive consideration, we were wholly unable to discover the slightest tendency to curvature, or that the blades were otherwise than perfectly flat, like the plates of a smoke-jack, a specimen of which was also exhibited. Moreover, it does seem to us highly improbable that the defendant, who was contending, and attempting to prove, that he had not infringed the patent, should produce models of such a shape as necessarily to destroy the case which he was attempting to set up. On the other point, however, whether the alleged invention be new, some of the observations already made have a material bearing. It appears, that in the patents

of Trevethick and Cummerow already referred to, a screw of one or more turns was in use, and in the description of the drawing, to which reference is made by the plaintiff in support of his specification, the use of a complete screw is mentioned. Would then the reduction of a complete screw to an uncertain aliquot part of a fraction of it be an invention? We say uncertain, because the precise section or portion of a screw which is to produce the desired effect is not defined. "One or more curved blades," is the language of the specification, without any attempt to define, or even to approximate to the precise number which is best for use. In the case of Heath and Unwin, 13, Meeson and Welsby, cited at the bar, the patent was for an improved manufacture of steel by the use of a metallic substance, called carbonate of manganese, in that stage; and the other materials in the process were to be used along with from one to three per cent of their weight of carbonate of manganese. The defendant had by the use of other materials, to him unexpectedly produced that substance, but in a less quantity than one per cent. in weight of the steel in the crucible. That was so found by the jury, and the Court referred to the finding in their judgment; and if that be material it seems to show that *the quantity* of carbonate of manganese to be used in the process of that patent is material also. In the present case, as has been observed, there is no attempt to specify the precise amount to be subtractible from a complete screw that had been before in use. It does not appear this latter point was pressed at the trial. I am not quite sure that it was not, if indeed it was presented at all. It seems however to raise sufficient doubt to require the distinction to be raised, and to furnish a reason for the case undergoing revision, in addition to that already mentioned as to the proof of being satisfactory, to show an infringement of the patent, even if it be valid in point of law. Upon the whole, we are of opinion that the rule must be made absolute for a new trial.

### REDUCTION OF SILVER ORES WITHOUT QUICKSILVER.

Two new modes of reducing silver ore have been recently introduced from Germany into Mexico, which promises ere long to supersede entirely the use of that expensive agent, quicksilver. The discoverer is a Mr. Ziervogel. According to the present mode the ore is first calcined with salt, which converts the sulphuret into a chloride; it is then at once removed from the furnace to a suitable tub, or other vessel, and a hot solution of salt poured over it, which immediately takes up the chloride of silver, and holds it in solution; the liquid is then drawn into another vessel, containing metallic copper, when the solution is decomposed, the silver being precipitated, and the liquor, by a simple process, is brought to its original starting point, and may be used over and over again with but little loss of salt. In second process the ores, or sulphurets, are carefully roasted in a reverberatory furnace, until they are converted into sulphates, when they are thrown into a suitable vessel, and boiling water poured over them, which immediately dissolves the sulphates; the liquid is then drawn off, and the silver precipitated by the same method as the first process. The latter process is best adapted for ores which contain a large portion of iron and copper pyrites, as a certain quantity of sulphur must be present, to insure the conversion into a sulphate.

### NOTES AND NOTICES.

*Effects of the Hot Weather at the Iron Works.*—So intense has been the heat that most of the principal works have been stopped, the men being unable to proceed with their labour. The men at Goldshill, Toll-end, Imperial, and Brunswick works have suffered considerably. It is utterly impossible for any human being to stand the temperature of blast furnaces.—*Sun.*

*Electric Telegraph Struck by Lightning.*—The magnetic telegraph wire was struck by lightning at Lancaster, several times last week. It is too small to contain fluid enough to do harm. The sound in the office, which was accompanied by a few sparks, was like a pistol-shot.—*New York Sun.*

*A Golden Yellow.*—M. Guimet gives the following receipt for making a yellow colour, of a golden tint much more intense than the well-known Naples yellow. Take of antinomiate of potass (carefully washed) one part, and of minium two parts, grind and mix them well into a paste; then dry the paste, and reduce it to a powder; and, lastly, expose the powder for four or five hours, to a red heat, taking care not to raise the temperature so high as to disengage the oxygen from the lead and antimony.

*Air Guns.*—It is a curious fact, that although the air-pump is a modern invention, yet the air-gun, which is so nearly allied to it in the construction of its valve and condensing syringe, should have existed long antecedent to it; for it is recorded that an air-gun was made for Henry IV., by Marin of Liseau, in Normandy, as early as 1408, and another was preserved in the armoury at Schmetau, bearing the date of 1474. The air-gun of the present day is, however, very different from that which was formerly made, and which discharged but one bullet after a long and tedious process of condensation, while it now discharges five or six without any visible variation of force, and will even act upon a dozen, though with less effect.

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# Mechanics' Magazine,

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## OXLEY'S BUOYANT OR SELF-ADJUSTING PADDLE-WHEELS.

Fig. 1.

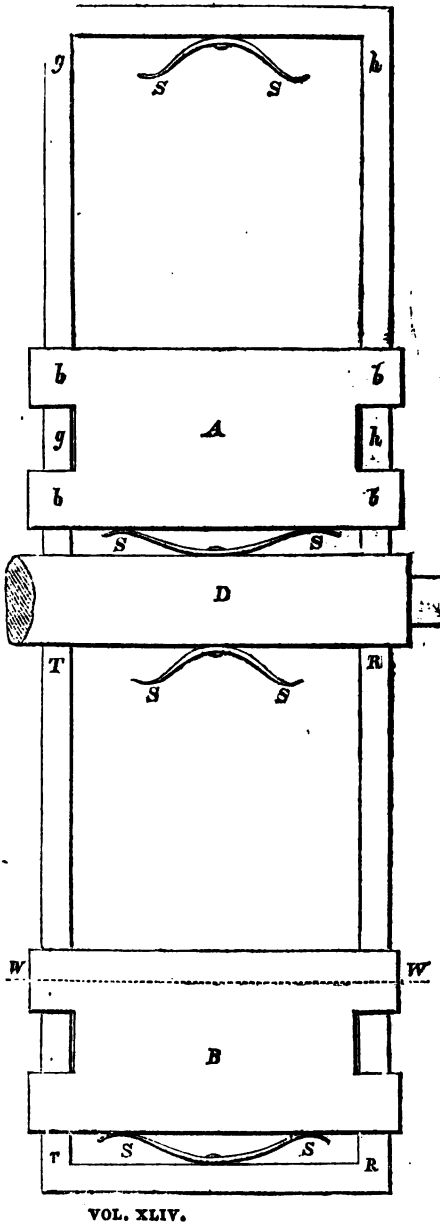
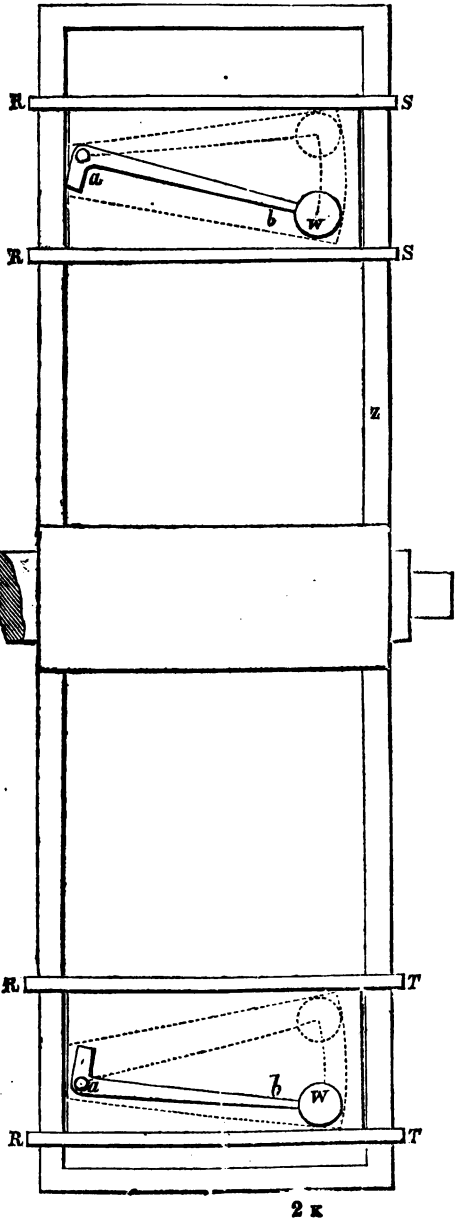



Fig. 2



## OXLEY'S BUOYANT OR SELF-ADJUSTING PADDLE-WHEELS.

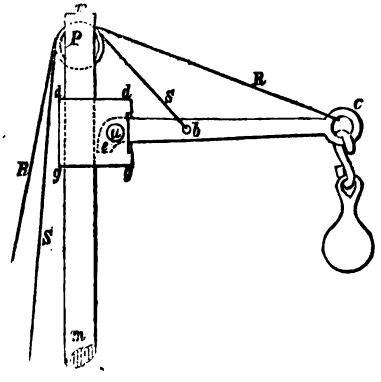
We gave in a former article (current vol. p. 162,) an account of Mr. Oxley's Expanding *Screw* Propeller. We now return to his specification of his patent in order to extract from it, as promised, the description there given of another class of improvements which have relation to *paddle wheels*, and which are equally distinguished by ingenuity and originality.

The *Second Branch* of my improvements have relation to paddle-wheels, and consists in making them self-adjusting under all possible circumstances, whether they are only under ballast or very heavily laden, or whether they have to work in a dead calm or against the strongest head sea, and that without involving any more strain or pressure on the engines and frame-work under one set of circumstances than under another. Paddle-wheels, as I propose to construct them, can never be water-logged as the common paddle-wheels frequently are, the pitching and rolling of the ship not being able to derange the equilibrium of their power and pressure on the water, and this will ensure, as I hope and firmly believe to the vessels employing them, a certainty and speed in performing quite unattainable by any paddle-wheel hitherto in use. The floats of these self-adjusting propeller wheels may be made either of iron, brass, copper, or any other suitable metal, or they may be made of timber and metal combined, as I have found by experiment that deal-wood planks, or wainscot planks, when secured together by metal braces, bolts and screws, will answer the purpose excellently, and that by the application of proper paint, varnish, pitch, &c., they may have great durability given to them. They are floats, not in name merely, like the ordinary floats, but veritable floats; they are not fixed tight and fast upon the radii, or spokes of the wheel, as usual, but are secured upon the spokes of the propeller wheel, by rings, staples, loops, or braces, of suitable metal, and slide freely up and down the spokes, being at perfect liberty to rise and fall with the waves of the ocean. Or, instead of the rings, staples, loops, or braces as aforesaid, I make a groove or channel at the end of each float, in the middle thereof, which groove or channel is fitted to the spokes of the propeller wheel, so as to let the float slide freely up and down. When the floats are made of timber, I recommend that inside such grooves or channels there should be fixed pieces or plates of suitable metal to strengthen them, and to prevent them wearing away too fast. With regard to the form of these floats, I do not limit myself to making them of any particular form. The form of a parallelogram will do very well, but that which I most approve of is the pentagonal.

The 1st variety of these self-adjusting propeller wheels which I shall describe, is represented in fig. 1. D is the axis of the wheel, which is purposely made of larger diameter than in the common paddle-wheel. *g g*, *h h*, are a pair of spokes, or arms, on the upper side of the wheel here represented, as being perpendicular to the water or horizon; and *r r*, R R, the opposite pair of spokes, which are also perpendicular, and immersed in the water as far as the line marked, *w w*. In case of a storm the leeward wheel might even be immersed as far as D, for in that case the float would be up close to the centre or axis of the wheel, consequently, these self-adjusting, propeller wheels cannot be water-logged, though the paddle-wheel would be so under similar positions. Each pair of arms has two metal springs attached to it, marked S S, S S, one spring being fixed by its centre on the drum of the wheel, and the other on the cross bar, *g h*, or *r* R. As the floats rotate to the upper side of the wheel, these springs enable them to descend gently towards the centre of the wheel without jarring or injuring the machinery. It will be well to varnish them with a solution of caoutchouc to preserve them from the effects of the water; *b b b b*, are metal loops, on which the floats slide up and down the spokes. A, represents the upper float as descended to the centre, and B the lower float, immersed, and floating freely in the water. I do not limit myself to making these floats of any given size or dimensions, but I consider it essential to the success of this branch of my invention, that they should be much broader and shorter than the floats of the common paddle-wheel. I find by experiment that it is well to make them from one-half to one-third part only of the length which is usually given to paddle-wheel floats, to which dimensions I judge it advisable to add one-fifth, or one-sixth part more of area than is usually found in the floats of paddle-wheels; and I add to, or diminish the floative power of each float, so that the said one-fifth or one-sixth part of the area shall, when immersed, always be above the surface of the water. I do not, however, limit myself to these proportions, and merely state them as furnishing good data for other engineers or constructors to go by, in following out this part of my invention. I believe that to reduce the length of the floats to one-third the length they are

made for paddle-wheels, will not only ensure their more perfect action of self-adjustment,

Fig. 3.




but will save two-thirds of the breadth across the midships that is now required for the paddle boxes. And further, in order that the full advantages obtainable from the use

Fig 5.

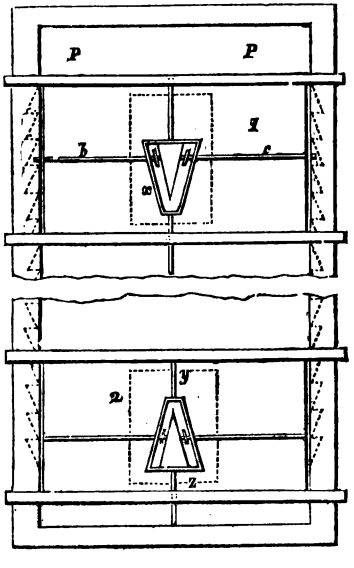



Fig. 6.

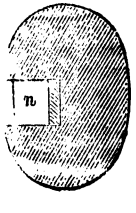
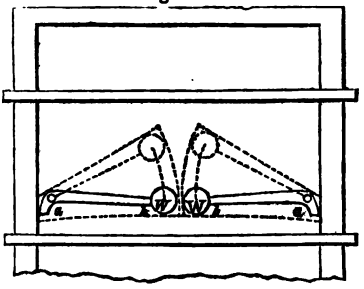



Fig. 4.



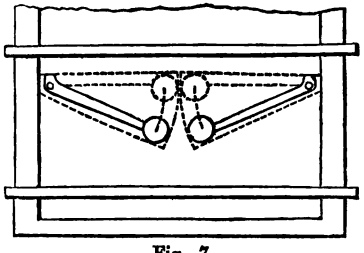
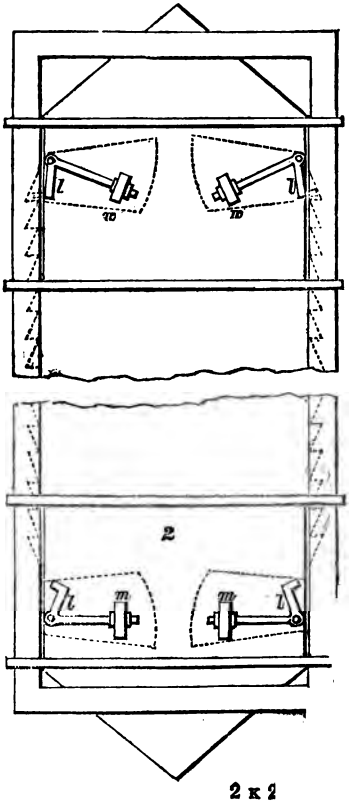


Fig. 7



of these self-adjusting propellers may be realized, I recommend, that for large ships or vessels, the diameter of the wheel should be made a few feet more than for ordinary paddle-wheels, so that the float may be able to catch the water and be fully immersed therein, on the windward side of the vessel, at the time the wind shall be blowing strongly. The fact, that the floats on the windward side thus increase their distance from the centre of the wheel in the same proportion as the floats on the leeward side are floated up nearer to the centre of the leeward wheel, shows clearly how these propeller wheels will, in their combined action, always preserve their equilibrium of power and pressure as aforesaid.

Another variety of these self-adjusting propellers is represented in figure 2. In this variety of propellers, I make use for each float, of one or more levers, either to make the float slide gently down upon the drum of the wheel, or to stop it altogether from going near the drum. This novel applicatian of the power of the lever to purposes of propelling is very nearly the same in plan, and precisely the same in principle as a simple machine which I invented many years ago; but never, till now, have made known, which I call the *Ships' Mast Climber*, or *Lever Crane*, for raising heavy bodies or weights, as casks, ships' boats, &c., and for various other useful purposes. An elevation of this apparatus is given separately in fig. 3; *m m*, represents a ship's mast, or any like upright pole; P is a pair of pulleys, either fixed in the top, or in a block having a socket fitted on the top of the mast or pole, so as to let them swivel about if required; or the pulley block may, by staples, rings, and other suitable means be placed lower down. *d d*, *g g*, is a sliding socket of iron, or any other suitable metal, in which is fixed the lever, *e*, *a*, *b*, C; *a* is the centre, or fulcrum, on which the lever turns; C is the end, or ring of the lever, from which the weight to be raised is suspended; R R, is a rope, fastened to the ring *e*, and fastening over one of the pulleys. S S, is a rope fastened to the lever at any convenient distance, say one-third, or one-fourth the length of the lever from the fulcrum. By pulling at the rope, S S, the weight is raised up to the height required, and on ceasing to pull, the weight, or body raised will remain steadily at the position which it has attained. Then, to lower the weight, the end C, of the lever is raised a little above the level (or horizontal line,) and kept so by gradually letting out the rope, S S. A weight will be raised much easier by drawing at both ropes, and pulling in such manner as to keep the lever in a horizontal line, or nearly so, all the while it is going up. In this manner I make any heavy body counteract the tendency to fall down by means of its own weight, and the heavier it is the more secure it will be from falling. A lever of the same kind or form, as that just described, is used in the second variety of the self-adjusting propellers represented in fig. 2. Two pairs of arms and the axis of the propeller-wheel are here shown. R R R R, and S S, T T, are rings, or loops, that secure the floats upon the wheel, and by means of which each float slides up and down. These floats are made of timber, and braced and bolted together with metal fastenings. I make them of two planks of timber, and cut away so much from each plank as to form a recess inside for the lever *a*, *b*, and its weight, W, to perform an arc of a circle in quite freely. A very strong bolt of metal passes through the fulcrum of the lever, on which the lever freely vibrates or turns, and the bolt is made secure by passing through strong plates or pieces of metal, also properly braced upon the timber. The action of the lever will be readily understood by inspection of the engraving. As soon as any float rises to the upper side of the wheel, the weight W, by its natural tendency to fall to the centre brings the short end of the lever to press hard upon the inside of the spoke, or arm, R R, and at the same time makes the inside of the rings, S S, bear hard upon the inside of the spoke, Z, whereby the descent of the float is either totally prevented, or otherwise it slides gently down towards the axis, and simultaneously therewith, the effect of gravity causes the weight, W, to fall down into the recess, as far as it can, whereby the short end of the lever is completely disengaged from touching the spoke of the wheel, and leaves the lower float at perfect liberty to rise or fall according to the rising and falling of the waves.

In fig. 4 I have shown a self-adjusting propeller with two levers to each float, *a b*. *a b* are the two levers; W W, the weights which just pass each other in the middle of the float. Two levers may be used extending nearly the whole length of the float; the weight then required upon each will not require to be more than about half what is required when the levers used are like those in fig. 4; and when two levers are used to each float, the rings that secure the floats upon the arms of the wheel need not be so loosely fitted as in fig. 3, because when two levers are used, each respectively presses against the spoke of the wheel it is nearest to, when by rotation it has come to the upper part of the wheel. In all other respects the action of the lever and floats is the same in this variety as in fig. 2.

A third variety of self-adjusting propeller

wheels is represented in fig. 5; in this variety a ratchet piece is attached to the inside of each arm, as shown, being let into a recess made in the arm for the purpose. If we suppose figure 6 to represent a section of the spoke of the wheel, then it will be observed that there is on each side of the ratchet a smooth surface for the floats, or their rings to rub against; so that the teeth of the ratchet cannot touch either the floats, or the rings, or sockets, they have to slide upon. In fig. 6, *n*, shows how the ratchet is placed in the spoke of the wheel. P P, fig. 5, represents each float; *x* the driver which consists of two V shaped pieces, one within the other, made of strong iron or any other suitable metal. In the outer V piece, there are slots through which two metal bars, *b* and *c*, are passed, each of which has a flat head and slides easily between the two V pieces. Each double V has two metal rods or stems, which slide through apertures made for them in the float. Now, by inspecting the upper float, as represented in the fig. 5, it will be seen that the driver by its action downwards has driven two bars, *b* and *c* outwardly into the teeth of the ratchet and so kept the float from falling upon the axis of the wheel, while, at the same time, the position of the float 2 shows that the driver by falling towards the extremity of the wheel from *y* towards *x* has drawn in the two bars, *b* and *c*, and so left the float at perfect liberty to rise and fall in the water as required.

Fig. 7 represents a fourth variety of these self-adjusting propeller wheels. In this, each float has two compound detent levers, each having a weight in the form of a friction wheel, or roller, turning freely at or near the long end thereof. I do not limit myself to making the lever always in the form shown, because the form may be much varied and yet the same effect be produced. The float 1, as here represented, shows that the effect of gravity has brought each of the roller weights into the position marked *w*, and that thereby the detent *l* of each lever has become locked safe in the teeth of the ratchet, which effectually keeps the float from falling to the centre. If the aperture in the roller be truly in the centre, this effect will happen at the very instant the arm of the wheel rises to a position a few degrees above the horizontal line.

In like manner float 2 shows by its position in the water, that the effect of gravity has brought the roller weights to the position, *m m*, and that the detents, *l l*, are free and detached from the ratchets, whereby the float is left at liberty to rise and fall in the water as required.

In the second, third, and fourth of these self-adjusting propellers, the recess which contains each weight and lever, &c., is placed inside of each float whereby the levers, &c., are protected from every accident or injury that might happen to them if they were placed externally upon the float. As I have found propellers of the fourth of these varieties by experiment to be the very best of any of them, in order that other persons may be enabled to make them act to perfection. I will, by way of instruction, observe, firstly, that the roller is much better than a single weight at the end of each lever, for a simple weight though passing over a smooth and narrow surface, does not act with the same unerring certainty of locking the floats as the roller weights does. Secondly, the points of the detents should be so placed that when the float is on the lower side of the wheel, these points may be very near to the teeth on the ratchet, yet not so near but that they will always keep clear of the said teeth in rising upwards. Thirdly, the teeth should all be of the same size, and the first and last tooth on each rack should be exactly opposite to the first and last tooth on the opposite rack. And, lastly, the first tooth of the rack nearest the periphery of the wheel should be at such a distance therefrom, that when the float rests upon the rim of the wheel the detent shall stand opposite the blank part of the wheel, and be the length of one or two teeth distant from the first tooth, for otherwise the float would not disengage itself and rise in the water as required.

## DESCRIPTION OF AN ECONOMICAL AND SMOKE-CONSUMING FURNACE.

Sir,—While the smoke nuisance and the abatement of it are occupying so much public attention, it may not be out of place to explain in your widely-extended Journal, a simple plan of furnace, easy and cheap to construct, and which, for the last sixteen or seventeen years I have found, however large or small the scale, to answer admirably. Many of my friends to whom I have communicated the plan have partially adopted it, and they find it very advantageous in practice.

In the first place, it saves in many instances half the fuel, and produces great economy of labour to the stoker. 2nd, It destroys the furnace very slowly indeed. 3rd., It consumes the greater part of the smoke, and I am of opinion, it can be nearly, if not wholly consumed.

The only difference between this and the usual plan of setting, is some trifling alterations in the fire-place. On the common plan the furnace is very confin-

with an immense draught, and the draught into the flue is close to the bottom of the boiler, that is, at the highest part of the fire-place; hence, the heat and smoke pass rapidly round the flue and escape into the chimney at a high temperature, imparting but little heat to the boiler in its progress, whilst the heat and smoke issuing from the chimney are immense, all of which, is of course a total loss.

On this plan the fire-place is as spacious as the bottom of the boiler will admit, but it does not follow that there shall be a much greater area of fire-bars than is usually employed. Nor any great variation in their form, but the thinner they are, and the closer in reason they are placed together the better. The draught from the fire into the flues is at the bottom of the fire-place, on a level with the bars, instead of the top, as in the old plan. This confines the heat immediately under the boiler where it is most beneficially active, and the rapid consumption of the fuel is hereby moderated into a close and more perfect combustion, which gives all the advantages above stated.

The propriety of this position for the flue is evidently a common sense one. I will endeavour to explain the mechanical action of it—not scientifically, I know, but I hope in a way to be understood. The hottest air by this plan is always kept in contact with the bottom of the boiler, (where the water or other liquid is coldest,) and imparts its heat to the water which condenses the hot air, then it gravitates to the flue and passes off. Hence, the gases escape into the chimney at a much lower temperature than would be the case if the draught were taken into the flue at the top of the fire-place. Or, for instance, if we wanted to obtain more power from a stream of water (which is an opposite element to fire,) we should construct a weir across it; this would not alter the discharge of water down the stream, but it would obtain the force of the fall at the point at which it was required. Keeping this in mind, it is fair to argue, that since heat expands the medium where it is created, that medium then ascends, and it has the greatest effect in a direction opposite to that of gravity. Therefore, if we wish to apply it to any particular point, as at the bottom of the boiler, we should keep the heat by reversing the position of the weir, and cause the gases to pass under, instead of over the dam, and hence the draught should be taken from the fire at the lowest point on the fire-bars.

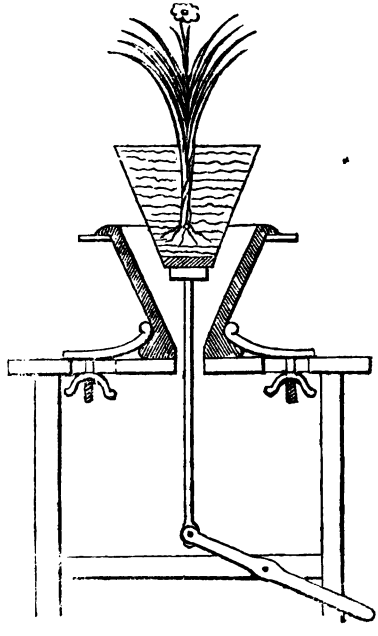
Increase of room in the fire-place is also a common-sense principle, and equally as easy of demonstration.

I am, Sir, your obedient servant,

JAMES DREDGE, C.E.

Bath, June 20, 1846.

## IMPROVEMENT IN GARDEN POTS.



Sir,—A patent has lately been taken out for a method of removing plants from pots, and an engraving of it is given in the *United Gardeners and Land Stewards' Journal* for the present year.* I did the same thing some years ago, and published it in *Loudon's Gardeners' Magazine*, for 1843, p. 137; and now have made a further improvement. In the first place, I have the pots made with a rim round the bottom, so that by having two sliding springs fixed on the potting bench, the pots slide easily under the ends of the springs, which firmly hold the pot. The foot moves

* The invention alluded to was not patented, but registered, and was first described in *Mech. Mag.*, current vol., p. 184.

the lever, which then raises the plant, the pots having moveable bottoms. Both hands of the operator are thus at liberty to receive the plant, which is a great convenience. These springs can be easily moved to suit any sized pot by having merely a thin screw on the underside of the bench, as shown in the engraving. There is also a moveable zink rim on the top edge of the pot for protecting plants and flowers from the slugs, because they will not pass over those rims; when they ascend the side of the pot and their horns or feelers come to touch the under side of the rims, the zink exercises some repulsive effect which causes them instantly to retreat; pot, wood, and iron they will pass over. I am, Sir, yours,

M. SAUL.

Natebey Cottage, Garstang, June 13, 1846.

## WHITE'S PATENT FIRE-ENGINE.

Instead of making use of two large pumps, such as are in general use, and which require from twenty-five to thirty-five men to work them, and in some large ones forty and upwards, the engine now submitted to the public consists of an indefinite number of small pumps of very great power, from twelve to twenty-four if needful. Each pump is a perfect fire-engine of itself, but the whole are so arranged as to discharge their contents or water into a common receiver or air-vessel, and from thence to the fire in the usual way. By this method each man can exert a power upon his respective pump equal to 70lbs. upon the square inch, while by the engines in common use, it requires the united power of thirty men to produce an equal pressure! Moreover the engines now in use are so constructed that the men who work them may become either a help or a hinderance at their pleasure; nor is it possible to detect or find out who the lazy parties are. But this evil is rendered impossible by the engines now brought under notice, for as each man works his *own pump*, he must either do his duty or stand still. Again, the common engine cannot be worked at all until the needful complement of men are found; whereas, by the plan proposed, if only one man can be found, he may instantly commence pumping, if another be at hand to conduct the hose. One man can raise water to the height of 160 feet, an advantage that must speak for itself; and with such an engine on the premises, it is presumed a fire in its early stage might be put out, for the want of such means often proves destructive. Another point is, that a trifling accident often renders the present engines useless, and for this reason; the combined power of thirty or forty men is thrown upon single parts of the machine, which, by the extra efforts put forth at fires occasions a break down, when all is at a stand. This is rendered impossible by the arrangements of Mr. White; for as no power beyond that of *one man* can act upon each respective pump, it is scarcely possible for any break down to take place.

The power in this engine is, in short, tenfold more, man for man, than in the common engine. Of its capability of throwing water higher and further than by any other arrangement hitherto adopted, the following report may be considered as furnishing conclusive evidence.

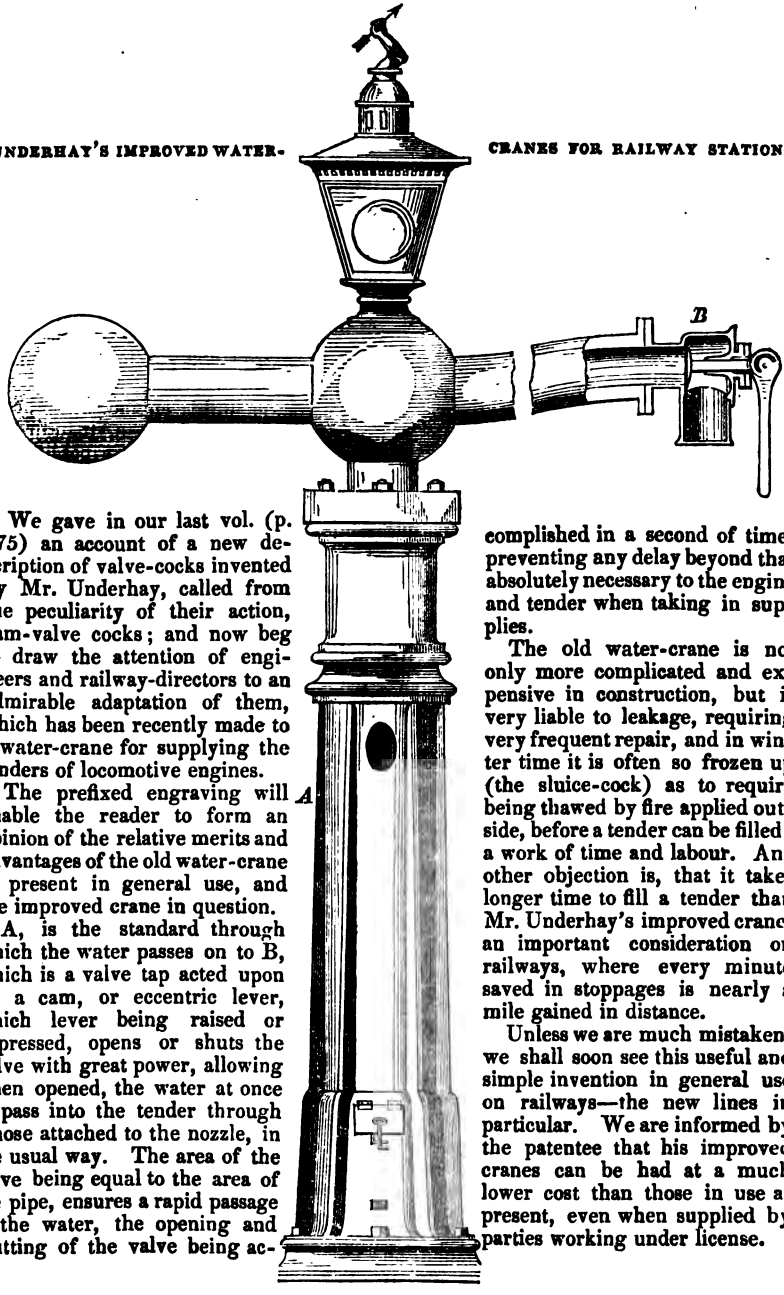
*Report of the Fire Engine Sub-Committee on the Trial of Mr. J. White's Patent Model Fire Engine, at the Salford Gas Works, Dec. 13th, 1845.*

The chimney of the Gas Works, which is 129ft. high, was the mark to show what height Mr. White's engine, and the *Deluge* engine, belonging to the Town Council, could throw the water, both being worked by the same number of men. When the model engine was set to work with twelve men, its full complement, it for a short time threw the water several feet above the chimney; afterwards the same number worked the *Deluge*, but could not succeed in throwing the water more than half the height, and additional men were then placed continuously until they numbered thirty-eight, but with their best efforts never reached the top of the chimney. Three lengths of hose-pipe were then attached to each engine, about 120ft. in length, each having a five-eight nozzle, when the result was equally in favour of the model engine with the first trial, proving that the principle of Mr. White's engine is a *decided improvement* upon fire-engines now in use, and in our opinion likely to become of great national benefit in the extinguishing of fires.

PETER GENDAL,
H. SAGER,
JOHN JEPSON PARKER,
WILLIAM MORRIS,
THOMAS H. UNDERWOOD,

Town Hall, Salford, Dec. 24, 1845.

## UNDERHAY'S IMPROVED WATER-CRANES FOR RAILWAY STATIONS.




We gave in our last vol. (p. 375) an account of a new description of valve-cocks invented by Mr. Underhay, called from the peculiarity of their action, cam-valve cocks; and now beg to draw the attention of engineers and railway-directors to an admirable adaptation of them, which has been recently made to a water-crane for supplying the tenders of locomotive engines.

The prefixed engraving will enable the reader to form an opinion of the relative merits and advantages of the old water-crane at present in general use, and the improved crane in question.

A, is the standard through which the water passes on to B, which is a valve tap acted upon by a cam, or eccentric lever, which lever being raised or depressed, opens or shuts the valve with great power, allowing when opened, the water at once to pass into the tender through a hose attached to the nozzle, in the usual way. The area of the valve being equal to the area of the pipe, ensures a rapid passage of the water, the opening and shutting of the valve being accomplished in a second of time, preventing any delay beyond that absolutely necessary to the engine and tender when taking in supplies.

The old water-crane is not only more complicated and expensive in construction, but is very liable to leakage, requiring very frequent repair, and in winter time it is often so frozen up (the sluice-cock) as to require being thawed by fire applied outside, before a tender can be filled; a work of time and labour. Another objection is, that it takes longer time to fill a tender than Mr. Underhay's improved crane, an important consideration on railways, where every minute saved in stoppages is nearly a mile gained in distance.

Unless we are much mistaken, we shall soon see this useful and simple invention in general use on railways—the new lines in particular. We are informed by the patentee that his improved cranes can be had at a much lower cost than those in use at present, even when supplied by parties working under license.

## IMPROVEMENT IN SMITHS' WATER TUE-IRONS.

Fig. 1.

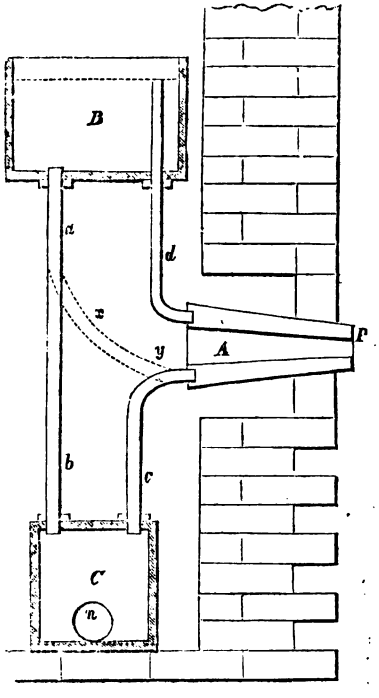
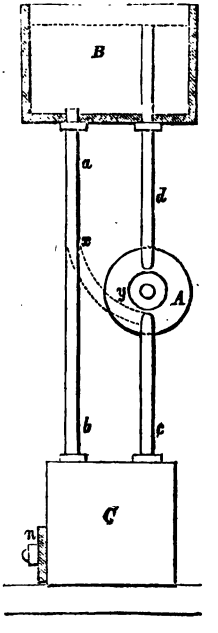



Fig. 2.




The smiths' water tue-iron as fitted up on the ordinary construction, is bad in principle, lasts a very short time before it is destroyed, and is eminently calculated for being an expensive item in the economy of the smith's workshop. Much inconvenience and hindrance results from the frequent stoppage occasioned by the failure of the useful appendage to the smithy fire.

My attention was directed to the circumstance eight or nine years ago, with the intention of finding a remedy for, or at least an amelioration of the evil.

Upon examination of the disabled tue-irons, I found the inside, more especially the end nearest the fire, generally filled up with a substance sufficiently solid as to prevent any water getting to that part; the place where it is most required to carry away undue temperature; thus the tue-iron is not fairly worn, but burnt out before its time.

What is meant by the ordinary construction may be understood by reference to figs. 1 and 2 of the prefixed sketch:—

A, Water tue-iron.

B, Cistern for water, at a convenient height above A.

*a x y*, Wrought iron pipe, connecting the lower part of the cistern, B, with the lower part of the tue-iron, A.

*d*, Another pipe, connected with the upper part of A, and passing either through the bottom of the cistern, B, or by one side, and over the top with a bend.

Water poured into B will descend by the pipe, *a x y*, into the tue-iron, A, driving the air before it up the pipe, *d*, and if sufficient water be supplied till it stands at the height shown by the line in the cistern, the whole of the pipes and tue-iron will be full of water.

In actual working, the nose, P, is covered with burning coal; the water soon attains a boiling temperature, and steam being formed, a portion of the water is driven out of the tue-iron up the pipe, *d*, into the cistern, B; when a fresh supply descends by *a x y*, to be in its turn heated and driven out as before.

If distilled water could always be supplied to the cistern, B, and that kept clean, the tue-iron would have a fair chance of do-

ing its duty to the end; but as it is not so, and as there is a great probability that other substances get into the cistern, and ultimately find a settlement in the tue-iron, some contrivance was desirable for preventing the accidental, or perhaps in some instances, wilful choking of the tue-iron.

The means adopted for this purpose will be readily understood by again referring to the two figures.

Instead of the water descending by the curved pipe, *a x y*, it is conveyed by the straight pipe, *a b*, into the cast-iron box, C, which is fixed considerably below the tue-iron, and must first be filled before any can rise up the pipe, *c*, into the tue-iron.

Should any sand or ashes get into the cistern, B, it will settle in the box, C, and not in the tue-iron, which will be supplied with water containing no heavy particles.

A mud-hole door, *n*, is provided by which the box may be cleaned out at any time when the work is not going on.

This additional apparatus if attended to will ensure a satisfactory working and add a considerable period to the existence of the water tue-iron.

The box, C, I have made is of the capacity of one cubic foot to each fire, and I would recommend that the mud-hole door be opened every two or three weeks according to circumstances.

W. NOTON.

Salford, June 7, 1846.

## A SCIENTIFIC TORNADO!

Sir,—You set yourself up, and show fight about our university system of analytical mathematics. Beware, Sir, or you may find the blow recoil. Your time to enter the lists with us is not yet come. It is true, too true, that we are receding from the high ground that our fathers won for us: and that a low faction in our university has succeeded, to a certain extent, in *vulgarizing* the character of our mathematics, and in converting the classic banks of the Cam into a drilling-ground for the intellects of the "great unwashed!" Even yet, you may rest assured, this discreditable faction will be driven into the holes and corners of the university, if even allowed to hide like vermin in the chinks and corners of the "small colleges." After all, it is not in the snail's pace with which the mechanical world will or can advance in science, that you and your class can ever be placed upon competing terms with us—except, indeed, we retrograde with a rapidity unprecedented in scientific history. You can never, Sir, meet us upon terms approximating to equality. You may consider our analytics to be "mystified;" yet that is solely owing to your own want of comprehension. Even were they mystified, they do not exhibit the *palpable absurdities* which are to be met with at every turn in the writings of your "practical men;" and according to your own confession, you (even *you!*) cannot take up the book written by your professional brethren, involving the most elementary mathematics, without an involuntary suffusion of shame coming over you. Would you not, therefore, better consult both your interests and your reputation, by confining yourself to the instruction of the ignorant persons who compose your own class, than by pretending to take cognizance of what occurs in this or any other university? You are, *evidently*, not "one of us," and you can, *therefore*, know nothing about the workings of our system; and it approaches very closely to impertinence, and certainly bespeaks the meddling spirit of the age, for you to offer an opinion, or in any way comment upon the affairs of *the* University of England. We do not profess to write to be read and understood by you, and such as you; and we leave *practical mathematics* to "the hewers of wood and drawers of water," whom such things may concern for supplying their own "bread and cheese." Your mathematics is composed of gross material handicraft; ours is the essence of the purest and most refined intellect.

If, Sir, a knowledge of pure mathematics be of so much importance to the classes which you are pleased to distinguish as the "professions" of architecture and engineering, you would much better consult the interests of those persons who are capable of being influenced by you, were you to urge upon them the advantages to be derived from studying their three years in this university. Though probably they may not be exactly of the class that gentlemen like ourselves could associate with, they would have the advantage of our lectures; and they would be company for each other, so as to prevent them from feeling "dull." They could matriculate in the "small colleges" and "houses;" and we should not feel them any incumbrance, if they only retained a due sense of their *permitted* residence

amongst us. They would inevitably become mathematicians of an order that would infinitely transcend any of the humble persons to whom you appear to look up as oracles; and if they have anything like *νους* they may rank as a secondary class amongst ourselves. If mathematics be really necessary for your "twin-professions, (which I very much doubt,) they would enter upon their professions with advantages which are in no other way attainable; and they would put to shame the barbarous and primitive style which you are obliged to own, disfigures all the mathematics which emanate from amongst yourselves. You may preach at your brethren till doomsday in your trumpery *Miscellanea Mathematica;* but they will be as the "deaf adder," and as ignorant of everything worth knowing in the form of science at the end as at the beginning. In truth, Sir, I am very doubtful whether you, yourself, editor though you be, possess any adequate idea of the *profound analyses* which we cultivate in this university. Your single reference to the most elementary view of common, or "arithmetical," algebra, whilst you constantly insist so much upon geometry, bears me out in this belief. Geometry is little, if anything, better than mere mechanism, and therefore more in your own way; but analysis is the quintessence of human intellect in its most refined elaboration. Why then, Sir, do you venture out of your own depth, in commenting upon *our* system and *our* studies? Remember, Sir, the adage, *nec sutor ultra crepidas**—but, probably, you cannot read Latin.

B. A. CANTAB.

June 22.

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*Note.*

We have printed our extraordinary correspondent's extraordinary letter *in extenso* for two reasons. The first is, that we may punish him for his impertinence by allowing him to write himself down—what he is; and the second, that we may make use of him as a flagrant, and so far instructive example of the prevalence of an opinion in respect to the uses of mathematical learning, which we deem it of importance to expose, and if possible, put an end to. First of all, however, we must, in justice to our many university friends, observe that we are far from regarding this "B. A. Cantab" as a type of the respectable class to which he *nominally* belongs. We look upon him in no other light than as one of those empirics of whom we have erewhile spoken,—who strut about in the plumes of their *alma mater*,—plumes which are insufficient to hide the naked deformity of their own coarse and vulgar minds. We have the satisfaction to tell "B. A. Cantab," that we number amongst the contributors to this work men who have obtained the highest honours that Cambridge has to bestow, and amongst our personal friends many more such. They, we know, will repudiate the letter, and feel ashamed of its author. Men of science and men of correct feeling do not indulge in such empty vapouring; and upon the *tone*, as well as the absolutely illiterate character of such a letter, they will bestow unqualified condemnation.

The matter of opinion to which we have referred as not being peculiar to this writer, is the suitability of the Cambridge course of studies to the requirements of the engineer and architect. We know that it is largely participated in by the "middle classes," who know nothing of university matters, and are deluded by the aphorism—"Mathematics is mathematics." To such readers we shall address a few words,—at present very few,—but shall return, in all probability, to the subject hereafter more in detail.

Our regularly qualified professional men are men whose intellect is almost uniformly above the average, and many of them possess minds of the highest order. In fact, as we have before stated, the engineering and architectural professions are only chosen by youths of ability and promise. Any strictures that we might have made, either in our "Miscellanea" or elsewhere, have had no reference whatever to any presumed want of ability, but to the flagrant neglect of one branch of their education, which is of the utmost importance to every member of the "sister arts." Speaking generally, they have mistaken the character of mathematical science, and its bearings upon their daily wants. We are convinced that the value of this branch of learning requires only to be made obvious, to induce as earnest a devotion to it amongst our students, as to any of the more fascinating branches of their education. It is not, however, by such persons as "B. A. Cantab," that this is to be done. He is one of those who imagine that mathematics is of no use at all to the "hewers of wood and drawers of water." And yet we hardly think he would venture to affirm that in the real *applicatory* mathematics, Cambridge itself is a step in advance of the ordinary practice of our professional men. It is true that there may be particular individuals to whom such mathematics may become *professional* or *attractive*; but this circumstance, though

* Sic in original.

it might have produced a Babbage, a Willis, a Moseley, or a Whewell, by no means affects the general truth, that to mathematics applied to practical purposes, no specific attention is either given or inculcated in that university; and we speak only of the men whom Cambridge as a university ordinarily produces. Those refinements which have generally been elaborated for the senate-house, where there has been any professed application of the science, have had reference almost solely to physical or descriptive astronomy and the undulatory theory of light. They imply a great deal of "hard work;" but the dexterity which such mathematical exercise creates, is in general very different in its nature, from that which is required in the engineering and architectural professions. Be it remembered, too, that the preparation for the examination preliminary to the B. A. degree, has been the labour of the entire life of the student till he has arrived at from twenty-three to thirty years of age. A course of study like this would, from the time it occupies, be totally incompatible with the student afterwards acquiring adequate *practical* knowledge of either profession. It would, in fact, be precisely analogous to our university M.D.'s, in whose professional skill few persons would place the least reliance, however much we may give them credit for other accomplishments than a knowledge of pathology and the *materia medica*. The entire arrangements of our social system are opposed to such a plan.

We do not deny (indeed, on the contrary, we contend for the truth of the statement) that the man who has gone through the university curriculum, has acquired many advantages for the study of some branches of engineering—especially to the dynamical problems arising in it. He is (mind, we still except the general run of "poll-men,") generally *au fait* at his integrations, and has acquired a facility in forming the differential equations of given kinds of motion—powers of no mean value in such researches. They are, however, powers existing in a state of isolation, and *there* purchased at a price of time, and other acquirements, for which the professional student must suffer during his whole after-life. He is, on the other hand, generally very innocent of any special skill in the *geometry* of the subjects that come before him, and he has the simplest operations in practical construction yet to learn—to no one of which have his studies at the university in the slighest degree *trained his mind*. His advantages and disadvantages, even as to acquirements, are co-extensive; and the great disadvantage of *lost time* is a most serious drawback on the plan of educating young men to be engineers or architects at the university of Cambridge. Neither is this plan at all necessary; for much more than the ground-work of a mathematical education adapted to our wants may be laid before the age of seventeen or eighteen (the ordinary age at which youths enter into articles,) were a course of mathematics but framed having that immediate object in view. The illustrations and examples should, in such case, be drawn as much as possible from cases of actual or possible occurrence in architecture and engineering; and a considerably greater portion of professional knowledge would thus be brought by a young man at once into his office, than is generally found under existing circumstances.

We have thus briefly attempted to point out an error into which many of our readers, who perceive or admit the advantages that mathematical acquirements will confer upon their sons who are destined for either of the professions, are very liable to fall into—of securing those advantages by sending their sons to Cambridge. Let them rather select one of the three institutions expressly devoted to the branches of learning proper for him to study—the *College for Civil Engineers*, *University College*, or *King's College*. Above all things, let them assure themselves by strict personal enquiry, and the advice of friends of competent judgment, which of the three is the best adapted to furnish a sound mathematical education, with the greatest possible amount of practical and applicatory information added thereto. Let no idea of convenient locality interfere with the choice; nor any personal considerations interfere with the particular and proved merits of any one. So let every parent decide—and in accordance with his decision let him act.—Ed. M. M.

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### THE TITHE-COMMUTATION SURVEYS.

Sir,—I am informed that the "Commissioners" restricted the parochial surveys to be made by the *sole use of the cross-staff and chain and that they refused to sanction any survey in which other instruments than these were employed!* Now this appears to me so preposterous a course of proceeding that, credible as the source of my information appears to be, I cannot bring myself to give it credit without further enquiry. Can you, or any of your correspondents, tell me whether this extraordinary statement be true or not; and if not true, what method was *actually prescribed* and what criteria of the *accuracy of the work* was employed?

I believe the "Commssion" has nearly

done its work; and as it has been both constituted and paid by parliament, it seems but fitting that some little enquiry should be made into the *efficiency* of its labours, and the accuracy of its results. It surely ought to have based its operations upon scientific principles, and have brought to bear upon them the refinements of modern mathematics. Indeed, I am unwilling to think that it has neglected so obvious and imperative a part of its implied duties; and shall suspend my judgment till I am favoured with corroborative or opposing evidence.

One thing is, however, certain,—that an opportunity which can never occur again, has been lost, of determining the *contour lines* of the surface of the entire country. What a contrast does this form to the surveys made under the direction of the *Bureau du Cadastre* in France, thirty years ago! We call ourselves "a practical people," and yet we neglect one of the greatest works that could have been effected for aiding the judgment of statesmen and engineers as to national improvements! But I forbear for the present.

CENTURION.

Home, June 22.

## SAVAGE'S IMPROVEMENT IN CONICAL STEEL-GRINDING MILLS.

Sir,—The article in your Journal (page 462) on my improved mills for grinding coffee, cocoa, corn, spices, drugs, on board ships, has been erroneously headed "an *iron stand* for mills, for grinding coffee, *chocolate*, &c.," but on reference to the engraving, it will be perceived, that one chief advantage it possesses is *dispensing with any stand or post*, the back plate being made long enough to receive the fly-wheel within it, and allow the mill to be screwed against any wooden or iron flat surface; plenty of which exist on board ships, where, however, there is no floor room to spare. I may just remark, that these mills are not applicable to the manufacture of chocolate, although they are for grinding the cocoa, of which chocolate is made. Chocolate is best made by grinding cocoa between a pair of horizontal stones, provided with the means of heating them to about 200° Fahr., which delivers the chocolate in a liquid form. If you think a description of making chocolate would interest your readers, (it being known to comparatively few persons,) I will at some future time communicate a brief account of the process.*

The mistake adverted to has reminded me that I intended to have sent you a design for an iron stand for supporting mills for grinding coffee, spices, wheat, maize, malt, printing ink, &c., which possesses the advantage of preventing the possibility of that

* We shall be glad to receive it.—ED. M. M.

unequal abrasion of the grinding teeth which is the common cause of the rapid destruction of conical steeled *grinding* mills. It will be perceived that it effects this by the spindle of the mill being supported in plummer-blocks, which are *between* the mill and its fly-wheel and handles. These arrest any eccentric force, and prevent it from being transmitted to the conical grinding surfaces, which consequently remain *concentric* with each other for as long a period as the mill is in use.

The chief eccentric force which tends to *partially* wear and destroy a mill of the form represented in the engraving, is the weight of its fly-wheel, which forces the spindle down on the bush, or bearing fixed in the side plate of the mill, and wears it away at the bottom part. This, of course, causes the interior revolving cone to become eccentric to the exterior cone by approximity to its lower surface. After a little while, the teeth, instead of being employed in grinding the coffee, &c., are employed in grinding each other to their mutual destruction, thereby certainly in one sense "making good for trade," *i. e.*, my trade at the expense of the user of the mill.

When mills are made to revolve by the power of steam, &c., it is usually communicated to them by means of a rigger and gut-band, or strap, the effect of the tension of which is exactly the same as the downward pressure of the fly-wheel represented in the engraving, excepting that it acts much more rapidly, and produces the mischief in less time. Hence the necessity of the interposed plummer-blocks, which arrest the eccentric force, is yet greater than for hand-mills: indeed, the principle was first applied by me to mills driven by mechanical power, and being found efficient, I was induced to apply it also to hand-mills, by the fact that of the many hundreds which passed through my hands to have the grinding teeth recut on them, almost every one, without exception, was worn out at the lower part, where the weight of the fly-wheel had caused the grinding cones to approximate to each other, while the upper part was but little abraded. It is also obvious, that before the teeth touched and destroyed each other, they must gradually have approximated, causing the substance which was being ground to be delivered much finer at the lower than at the upper part of the mill—an evil of considerable magnitude in most cases.

When it is considered that conical steel mills are used almost all over the civilized world, for grinding some hundreds of different substances, and that in London alone the uses of them may be numbered by thousands, the above description of a method of greatly increasing their durability, and thereby practically reducing their cost, may be acceptable to your readers, as assisting to forward that civilization which is characterized by "making good or useful things cheap."

Respectfully,

ALFRED SAVAGE.

43, Eastcheap.

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### A FEW WORDS OF APOLOGY FOR THE "NEW THEORY OF PRISMATIC COLOURS."

Sir,—In page 366 of your current volume is inserted an article headed with the words given above within inverted commas. I have not the Number by me, but I forget not the object of the writer. Your correspondent, "J. M." of *Cambridge*, (page 417,) in objecting to his *initial* friend's suggestions, "J. M." of *Battersea* has, I am inclined to think, done him injustice. Sir, I considered the article of "J. M." above alluded to to have been written with the greatest humility. It professed to be only *suggestive*, not *dogmatic*. In your Cambridge correspondent's first paragraph, at the very outset, he seems in error. He states that "J. M." of Battersea endeavours *to prove* "that light of different colours has different velocities." Now, Sir, I believe he endeavoured *to prove* no such thing. He endeavoured to prove that (granting light to be matter) it must have different velocities, and, perhaps, different effects, varying as the distance from the point of primary projection from the sun. That is, the nearer you are to a cannon-ball projected from a gun, the greater its effect; and the farther off, the lesser the effect. He never attempted *to prove* that different colours had different velocities, but only *suggested*, with humility, whether the delicate organ, the eye, might not be differently affected by a difference in the velocity of a ray of light; that is, differently affected by a hard blow than by a slight blow; and, considering that as the difference of the intensity of a blow is due to different velocities, whether this organ, the eye, might not experience different sensations according to the power of the blow, and thus experience the sensation of different colours of light, without supposing, indeed, an *infinit*

(*not merely seven*) of "*different kinds*" or "*natures*" of light.

In other parts of his communication to you, he seems (if I understand him rightly) to jump to "J. M." *of Battersea's* own idea, that the sense of colour we experience may be due, *not to "different natures or kinds"* of light, but to the effect (somehow differing) of one and the same kind of light under certain circumstances causing a different sensation. Your "Trinity College" correspondent concludes thus—"I shall just add, that if this property of light were to be proved *true*, there would be *no greater simplicity* in supposing *different colours* to have different velocities, than to suppose "*different kinds*" of light. Now I differ from him here. The daily experience of the philosopher, the chemist, &c., convinces him that the GREAT CREATOR works with few materials. See the *few elements* of the chemist, and the numberless "*different kinds*" of matter therefrom formed. The number of these (at present supposed) elements may yet be very greatly lessened; and to me the chief beauty of "*the new theory of colour*" is, that perfectly contrary to your correspondent's statement—there is *a far greater simplicity* in supposing only "ONE KIND" of light than in supposing an *infinity* of "*different kinds*" of light.

J. N.

## LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC. CAP. 65.

| Date of Registration. | No. in the Register. | Proprietors' Names. | Address. | Subject of Design. |
|---|---|---|---|---|
| May 27 | 727 | William Swain | Pembridge, Hereford, brick-maker | Hand machine for making draining and other tiles, pipes, &c., with all kinds of clay, even the most unfavourable. |
| | 728 | Francis Bassano | Birmingham | Railway roof lamp. |
| 28 | 729 | Richard Robinson | Lisburn, agricultural implement maker | The Lisburn potato washing machine. |
| | 730 | James Parkes and Son, | Birmingham | Stock fastener. |
| | 731 | William Hopkins | Birmingham | Substitute for rack-pulley for blinds. |
| 29 | 732 | Josiah Carter | 65, Blackman-street, Borough | Lock spindle. |
| June 2 | 733 | John and Charles Ratcliff | 140, Suffolk-street, Birmingham, | Apparatus for raising and lowering chandeliers. |
| | 734 | Ditto | Ditto, ditto | Ditto. |
| 4 | 735 | Charles John Edwards, | 6, Beech-street, Barbican, London | Improved strap, or band, for driving machinery. |
| 5 | 736 | John Greaves and Son, | 56, South-street, Sheffield | Chromatic tuning fork. |
| 8 | 737 | Joseph Coward | 2, King-street, Snow-hill | Self-adjusting wrench. |
| | 738 | Thomas Wedlake | Bristol | Reversing apparatus for hay-making machines. |
| 10 | 739 | Souter and Hammond, | The Spread Eagle Works, Limehouse | Pneumatic tilt-hammer and pile-driver. |
| | 740 | Joseph Coward | 2, King-street, Snow-hill | Bed screw wrench. |
| | 741 | Ditto | Ditto, ditto | Screw wrench. |
| 11 | 742 | John Affleck and Co. | Dumfries, iron-founders | Improved drill and seed sowing machine. |
| 12 | 743 | George Cox | Southwark-crescent | The Stellar shot cartridge. |
| 16 | 744 | James Walby | 59, Greek-street, Soho, London, | Fire escape. |
| 17 | 745 | George Earl | Of the Peckham School of Design | Goniometricon. |
| | 746 | Henry Smith and Thomas Woodhouse Ashby | Stamford, agricultural implement makers | Haymaking machine. |
| | 747 | Charles Sparrow | 11, New North-street, Red Lion-square, London | Safety catch, applicable to bracelets, lockets, rings, &c. |
| 19 | 748 | John Major Aldridge, | 20, Nelson-street, City-road | Double-action door spring. |
| | 749 | Guy and Brown | 18, Brecknock-place, Camden-town | Window shutter. |

## LIST OF ENGLISH PATENTS GRANTED BETWEEN MAY 26, AND JUNE 26, 1846.

Nathan Defries, of Saint Martin's-lane, engineer, for improvements in gas meters. May 27; six months.

John Hyde, of Manchester, engineer, for certain improvements in looms, and apparatus connected with looms for weaving. May 28; six months.

Charles Heard de Boissimon, of Leicester-place, Middlesex, merchant, for improvements in manufacturing corks and bungs. (Being a communication.) May 28; six months.

John Aston, of Birmingham, button manufacturer, for improvements in buttons and in ornaments for dress. May 28; six months.

Alexander Southwood Stocker, of Camden-road Villas, gent., for improvements in the manufacture of bottles and other similar vessels, also in stopping or covering the same, and in the manufacture and application of the whole, or part of the articles to be used. May 28; six months.

John Blyth, of Saint Anne, Limehouse, engineer,

for an improved mode of closing the orifices of bottles and other vessels, applicable to inkholders. May 28; six months.

Richard Marvin, of Portsea, and William Henry Moore, of Southsea, both in the county of Southampton, gent., for improvements in gratings of metal or wood, for the fronts of houses and general purposes for the admission of light and ventilation. May 28; six months.

Henry Seymour Westmacott, 28, John-street, Bedford-row, gent., for an improvement in the construction of rotary steam engines. (Being a communication.) May 30; six months.

Henry Lawrence Tobias Tschudy Von Uster, of the college for Civil Engineers, Putney, for improvements in apparatus or machinery for measuring and indicating the distance travelled by wheel carriages. June 2; six months.

Moses Poole, London, gent., for improvements in making fabrics from fibrous materials. (Being a communication.) June 2; six months.

William Stubbs and John Isaiah Grills, of Llanally, South Wales, engineers, for improvements in locomotive and other engines and carriages. June 2; six months.

John Webster Cochran, of Paris, engineer, for certain improvements in machinery for cutting and shaping wood for ship-building and other purposes. June 2; six months.

William Carter Stafford Percy, of Manchester, upholder, for certain improvements in the manufacture of bricks, tiles, chimney tops, and other similar articles. June 2; six months.

Joseph Clinton Robertson, of Fleet-street, London, civil engineer, for certain improvements in railways and railway carriages. (Being a communication). June 4; six months.

George Lowe, of Finsbury-circus, civil engineer, of an extension of a patent for increasing the illuminating power of such coal gas as is usually produced in gas works, also for converting the refuse products from the manufacture of coal gas into an article of commerce not heretofore produced therefrom, and also of a new mode of conducting the process of condensation in the manufacture of gas for illumination; for the term of five years from the 9th day of June instant. June 4.

John Taylor, of Carlisle, miller, for certain improvements in flour mills and in machinery connected therewith. June 6; six months.

Robert Rettie, of Glasgow, civil engineer, for certain improvements in the manufacture of fuel, parts of which improvements are applicable for the purposes of purifying, compressing, or extracting vegetable and other substances, and fluids, and in the machinery or apparatus to be used for the same. June 12; six months.

Edward Cottam, of St. John's-wood, for improvements in bedsteads. June 16; six months.

Frederic Handell Burkinyoung, of Baker-street, Middlesex, gent., for improvements in piano fortes. June 16; six months.

Benjamin Fothergill, of Manchester, machine-maker, and Richard Johnson, of Clitheroe, in the same county, cotton-spinner, for improvements in certain parts of machinery used in the preparation for spinning, and in the spinning and doubling of cotton, wool, and other fibrous substances. June 16; six months.

Robert Reyburn, of Brown-street, Glasgow, chemist, for improvements in making extracts from animal and vegetable substances. June 17; six months.

William Cormack, of Thames-street, Greenwich, chemist, for improvements in obtaining motive power. June 17; six months.

Alfred Richard Johnson, of the firm of Messrs. Johnson and Co., of Regent-street, and Messrs. Griffiths and Johnson, of Old Bond-street, hatters, for certain improvements in hats, caps, and bonnets. June 18; six months.

John Simson, of Riches-court, Lime-street, merchant, for certain improvements in machinery for preparing and spinning flax, and other fibrous materials. June 20; six months.

Henry Austin and Thomas Webster Rammell, of 10, Walbrook, City, civil engineer, for improvements in wood, mosaic, and tessellated work. June 22; six months.

Spencer Thomas Garrett, of Cliff-bank Lodge, Stoke-upon-Trent, Esq., for certain improvements in cements, bricks, tiles, quarries, slabs, and artificial stones. June 22; six months.

Bennett Woodcroft, of Manchester, consulting engineer, for an improved mode of printing certain colours on calico and other fabrics. June 22; six months.

Thomas Walker, of Birmingham, stove-maker, for improvements in ships'-logs and in sounding-machines. June 22; six months.

John Mercer, of Oakenshaw, chemist, and John Greenwood, of Church, in the same county, chemist, for certain improvements in dyeing and printing Turkey red, and other colours. June 22; six months.

William Mathers Hall, of Leeds, brass-founder, for a certain improvement, or certain improvements in, and applicable to sliding gas pendants, lamps, lustres, and chandeliers. June 22; six months.

Joseph Renshaw, of Salford, Lancashire, mechanic, for certain improvements in machinery, or apparatus; for finishing velvets and other piled goods or fabrics. June 22; six months.

William Cotton, of Loughborough, manufacturer, for certain improvements in knitting machinery. June 22; six months.

John Gillett, of Brailes, Warwick, agricultural implement maker, for an improved apparatus for protecting property by sounding alarums, or giving signals. June 22; six months.

Joseph George, of Chelsea, Middlesex, coal and twine master, for improvements in the construction of houses, buildings, and other erections. June 22; six months.

Thomas Jones, of Salford, Lancaster, machine-maker, for certain improvements in machinery or apparatus for preparing, slubbing, and roving cotton, wool, and other fibrous materials. June 22; six months.

William Topling Nesham, of the London Docks, engineer, for certain improvements in the apparatus and mode of applying power for raising and lowering weights or heavy bodies. June 23; six months.

Ambrose Lord, of Allerton, Cheshire, toll-collector, for certain improvements in furnaces and the flues of steam-boilers, for the purposes of consuming the smoke and economising the fuel. June 24; six months.

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*The Great Britain: home voyage.*—The *Great Britain* arrived off the Orme's Head on Saturday morning last, having completed her return voyage from New York in a little over thirteen days. For ten days out of the thirteen, the vessel encountered a succession of strong easterly winds, but steamed, nevertheless, at the rate of ten, eleven and a half, and twelve knots an hour. For the last day but one of her voyage, she accomplished not less than 280 nautical miles. It is expected that under more favourable circumstances, she will perform the passage across in ten or eleven days. So much for improved machinery! and so much, too, for the screw!

## END OF THE FORTY-FOURTH VOLUME.

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